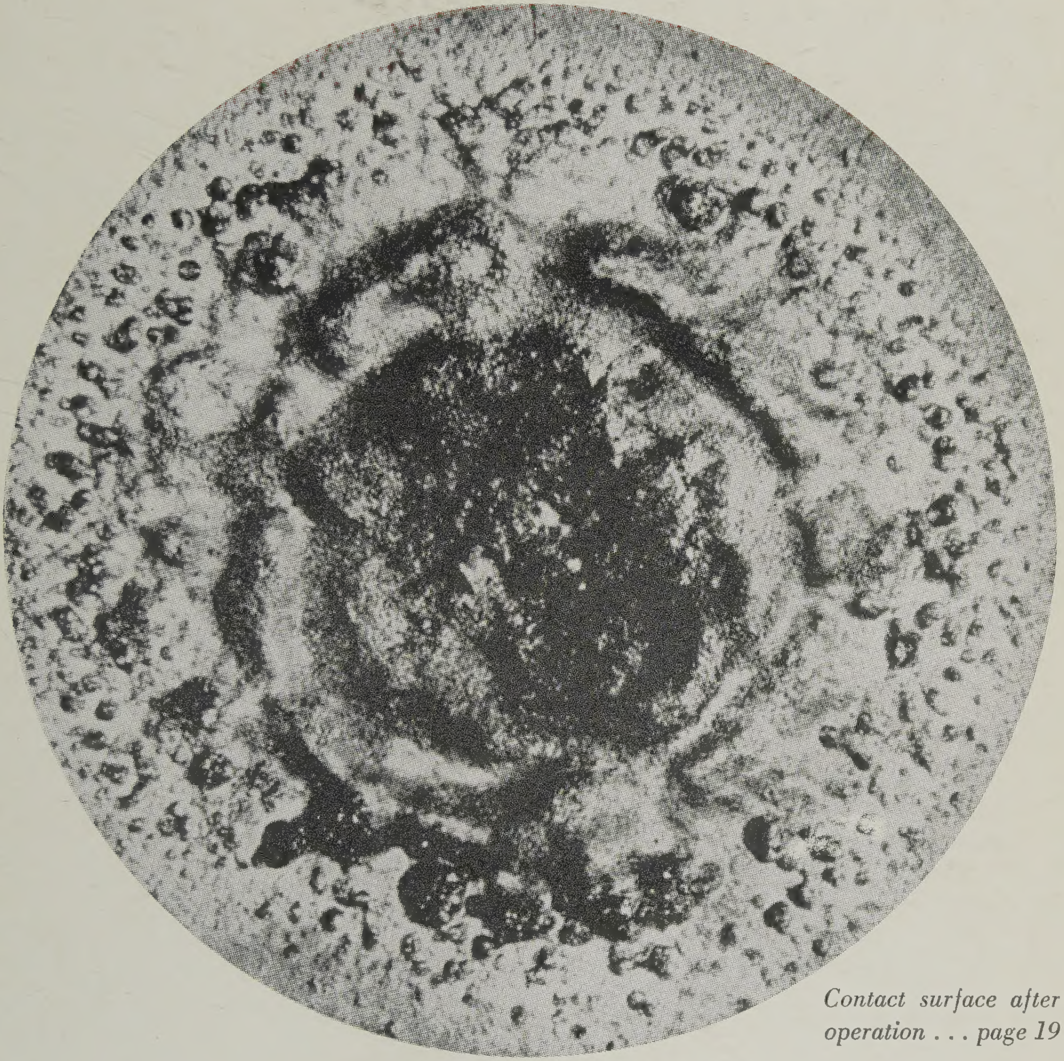
April 1960

Insulation



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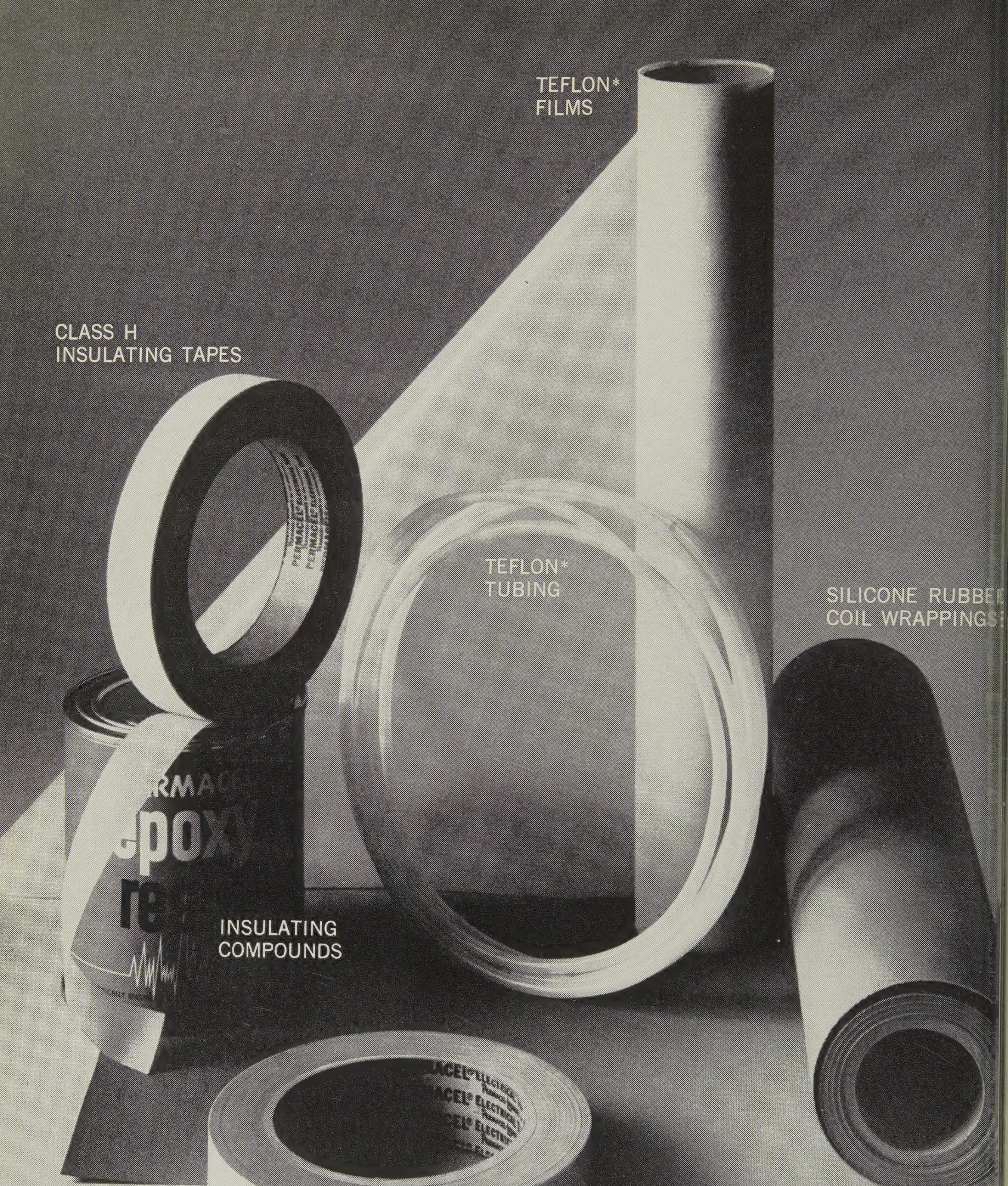

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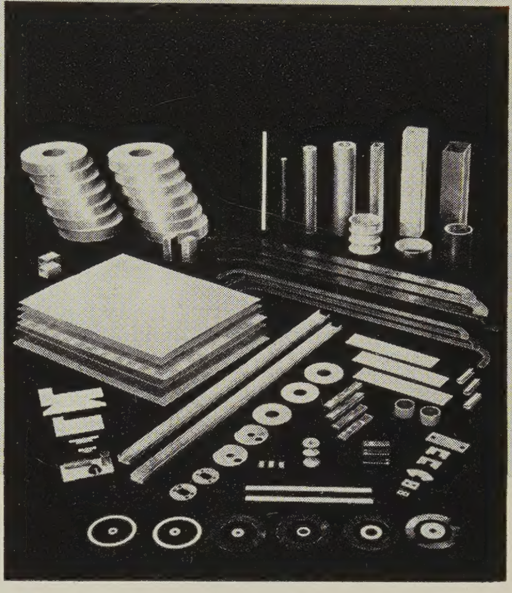

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Insulation

For the Electrical and Electronic Industries

Lake Publishing Corporation, 311 East Park Ave., Libertyville Illinois, April 1960

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L. E. Moberly

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H. K. Graves and L. E. Sieffert

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Insulation, April, 1960, Volume 6, Number 4. Published monthly by Lake Publishing Corp., Box 148, 311 E. Park Ave., Libertyville, Ill. Phone LIbertyville 2-8711. Accepted as controlled circulation publication at Mount Morris, Illinois.

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Advertising Sales Offices: See page 86.

From the Editor

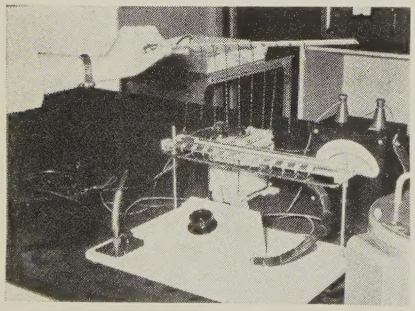
Opinions and Rambling Thoughts

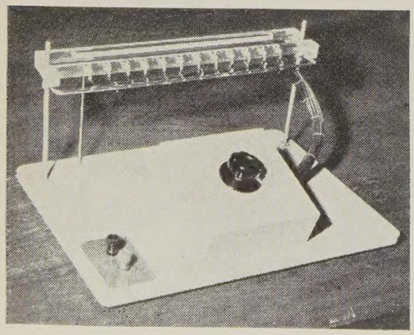
Magnet Wire Specimen Holder

Here is proof that ingenious engineers faced with similar problems can come up with similar solutions at approximately the same time and entirely independent of each other . . . and in this case quite a few miles separated the engineers. It seems that our article in the February issue, "Novel Multiple Specimen Holder Reduces Variables in Magnet Wire Thermal Investigations," by Lee M. Johnson and Maxwell E. Sharp of the U.S. Naval Research Laboratory, covered a matter which was already familiar to A. J. Taylor, chief technical engineer (winding wires), The London Electric Wire Co. & Smiths Ltd., London, England. Reader Taylor was kind enough to write as follows:

"We have found a similar sort of jig very useful in our work with this procedure, and I am, therefore, enclosing two photographs which you may consider to be of interest to your readers. We normally employ 12 specimens mounted in a silicone bonded glass laminated strip with the ends turned over to make contact with the mercury pools when the assembly is lowered on to the test jig. This method is most convenient, for a number of strips can easily be arranged on special racks which ensure the maximum utilization of oven space and the minimum handling of specimens.

"Incidentally, we make a practice of returning the strips in a different position after each exposure, to ensure that so far as possible all specimens receive similar heat treatment."





Only the Boss's Son

From Donald H. Moyer, director of the Office of Student Personnel, College of Engineering, Cornell University, comes word that an engineering degree is no longer a passport for college graduates to executive-sized jobs and salaries. To our way of thinking, in actual practice, this has always been true and if not, the passport was good for only a year or so because it should not take a company much longer than that to find out whether or not a man is qualified. True, there are marginal engineers who are able to sneak by year after year, but if we stop and look back, we might be amazed at how quickly a job can become marginal if it is filled by a marginal engineer. About the only passport to executive-sized jobs and salaries, other than ability and hard work, that still is in effect is the existence of a father who happens to own the company. However, even in the latter case, we suspect that most fathers demand more from their own sons than from someone else's son. We have long felt that the belief that a college degree opens all doors was strictly a myth.

Whitehead Insulation Award

As previously announced in *Insulation*, efforts are being made to solicit funds for the "J. B. Whitehead Electrical Insulation Award." Purpose of the award is to recognize outstanding achievements in the field of electrical insulation, to stimulate interest in the field of electrical insulation especially among young engineers and scientists, and to honor the memory of Dr. J. B. Whitehead, an illustrious leader in this field and former president of AIEE. The award itself will consist of $500 in cash and a suitably inscribed medal and certificate to be presented annually if a suitable candidate is found. The awardee need not be a member of the AIEE and the selection will be made on the basis of achievements in the field by the Professional Recognition Development Department of the AIEE with the help of other associations active in the electrical insulation field. You are encouraged to contribute to the necessary fund by using the coupon below.

Prof. F. Hamburger, Jr., Treasurer, Electrical Engineering Department
The Johns Hopkins University, Baltimore 18, Md.

I am enclosing $__________ as my contribution to the establishment of the Whitehead Award. My contribution should be credited to (cross out all except one): AIEE, NRC Conference on Insulation, NEMA, ASTM, Insulation Div. of Electrochemical Society. Please make checks payable to J. B. Whitehead Award Fund.

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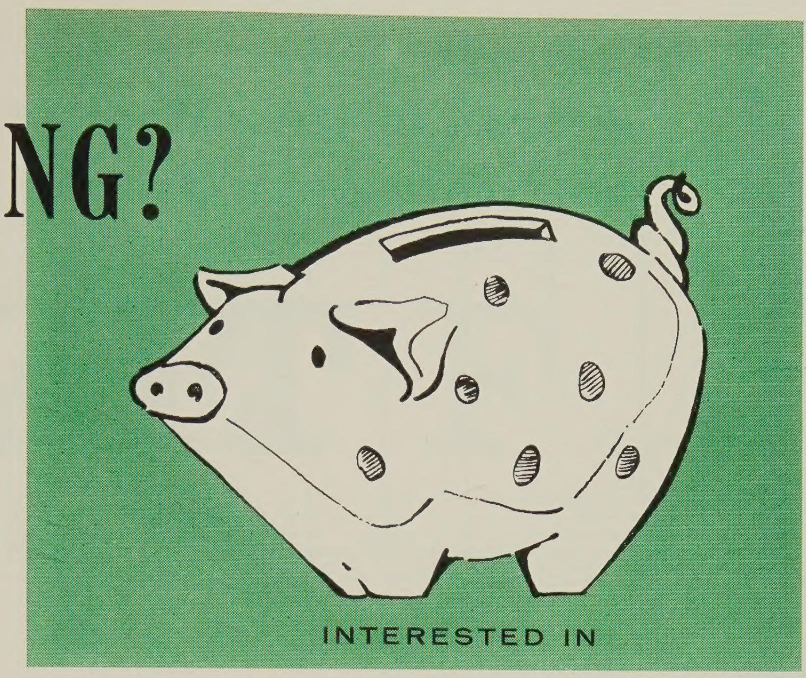

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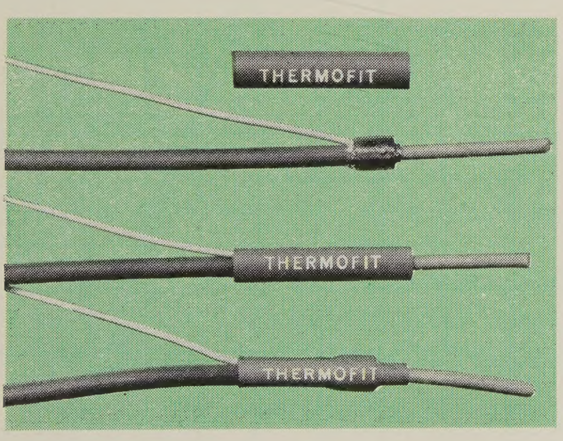

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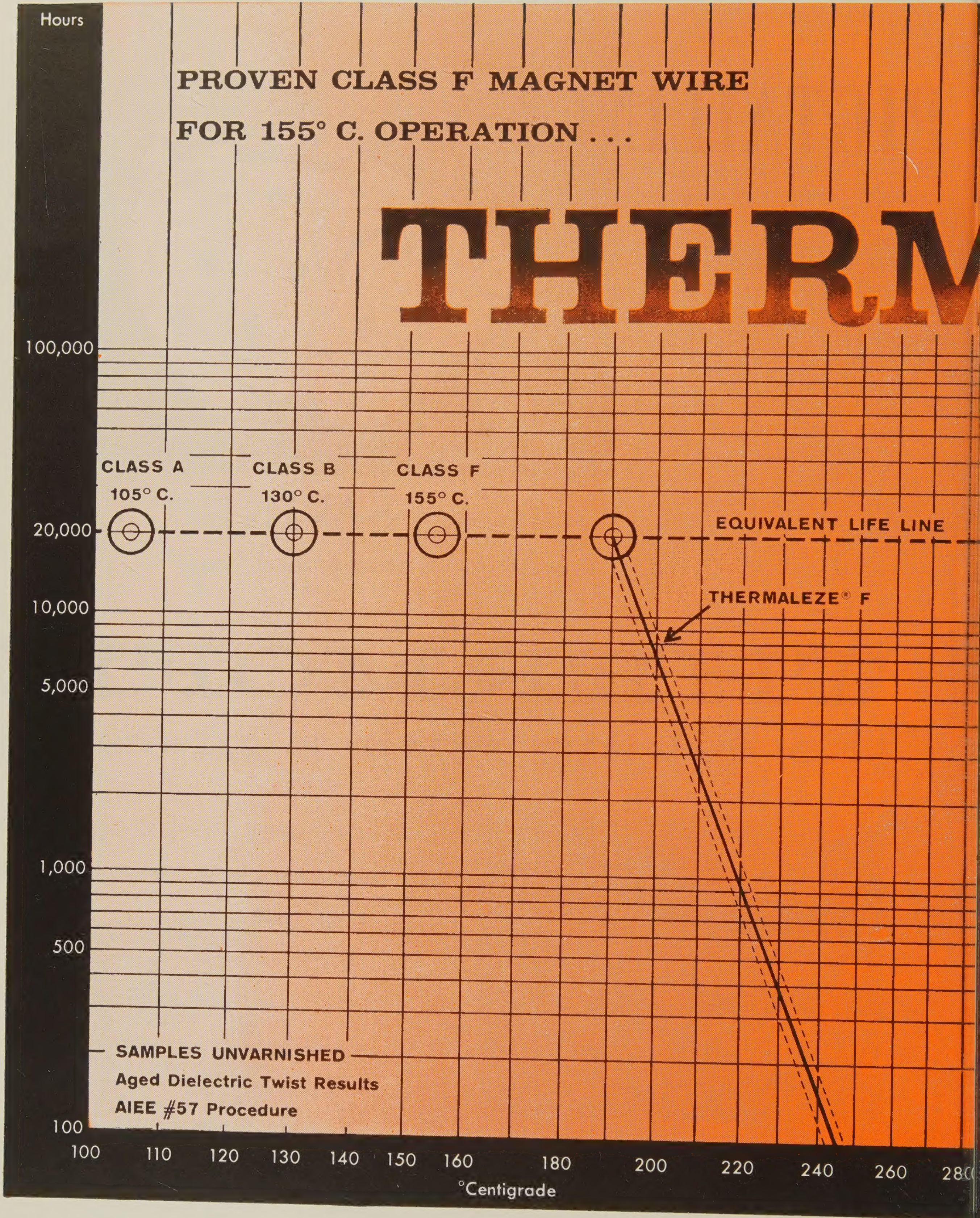

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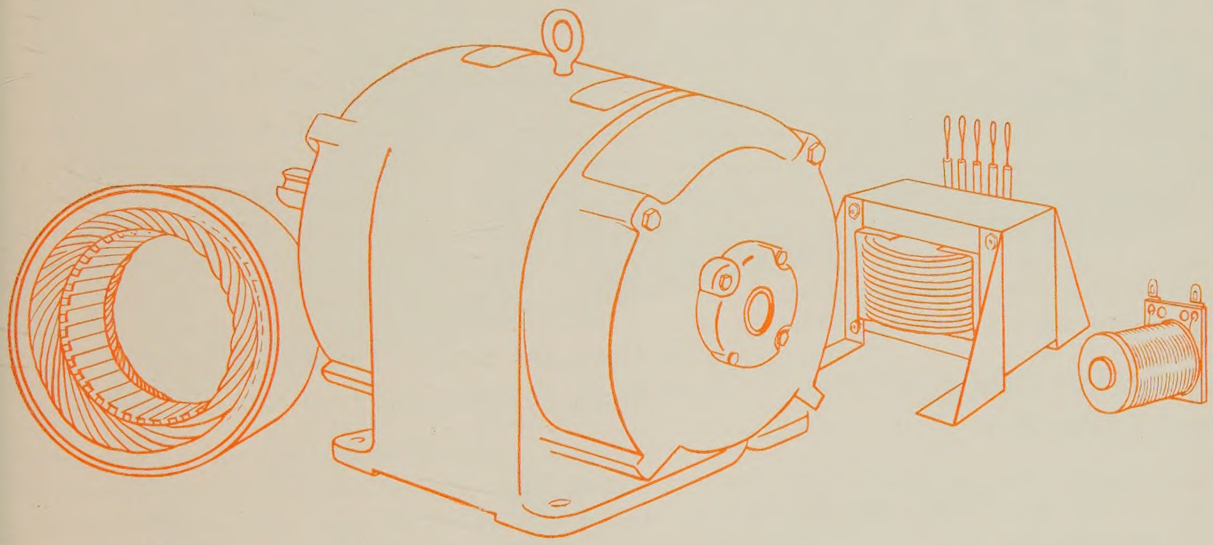

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News and Views

December Insulation Application Conference Plans Move Ahead

According to the latest committee reports, plans for the Third Annual Conference on the Application of Electrical Insulation are well under way. The conference will be held at the Conrad Hilton Hotel in Chicago, Monday, December 5 through Thursday, December 8. Many of the program details for the meeting have already been finalized and plans for other arrangements are also nearing completion. William Hoffer, Johns-Manville Sales Corp., New York City, is general conference chairman.

Present plans call for holding technical sessions Monday morning and afternoon, Tuesday morning, and Wednesday morning and afternoon, December 5 through December 7. Tuesday afternoon, December 6, will be devoted to exhibits only and Thursday, December 8, will be devoted to marketers' sessions. Most conference committee chairmen were announced on page 4 of last month's issue of *Insulation*. Not previously announced were the following assistants to chairman A. S. Gray, Insulation Manufacturers Corp., Chicago, of the local arrangements committee: J. H. Martin, L. R. Samelson, G. F. Fratto, A. J. Wiltjer, J. E. Byrne, R. G. Tiffany, J. P. Haughney, T. C. Keegan, D. W. Stewart, and J. C. Richardson.

Raychem Acquires Bentley-Harris, Loral Buys Alpha Wire

Bentley-Harris Manufacturing Co., Conshohocken, Pa., tubing and sleeving manufacturer has been acquired by Raychem Corp., Redwood City, Cal., producer of irradiated electrical and electronic insulations and components. The transfer plan involved the exchange of 50,000 shares of Raychem stock. The arrangement calls for Bentley-Harris to continue its present operations as a wholly-owned subsidiary of Raychem. Raychem, which had sales in the last six months of 1959 of $1,120,000 (up 106% over the comparable 1958 period), was formed three years ago.

Also in the news is the acquisition by Loral Electronics Corp., New York City, of Alpha Wire Corp., also of New York. Alpha will be operated as a division of Loral under the present management. Loral, with annual sales of about $17,000,000, produces electronic systems. Alpha sales for 1959 were approximately $3,000,000.

Brand and Rex Consolidated

American Enka Corp., which purchased the Rex Corp. in 1958 and William Brand & Co. Inc. in 1959, has announced that Rex and Brand are being consolidated into the William Brand-Rex Division. The new division manufactures insulated wire, cable, tubing, and plastics. Executive headquarters offices for the new division will be in Concord, Mass.

$1.6-Billion Chemical Construction

Chemical production and research facilities costing an estimated $1.657-billion will be constructed in the United States during 1960 and 1961 according to the Manufacturing Chemists Association. This figure includes $1.172-billion for construction already begun, and $485.5-million for projects scheduled for early groundbreaking and completion before 1962. Of the chemical industry totals, an amount of $450.080-million is foreseen for plastics and resins facilities construction.

British Bid for Cable Sales

In a bid to stimulate U.S. sales of British made cables, British Insulated Callender's Cables Ltd. is planning an extensive exhibit and display at the British exhibition in the New York Coliseum June 10 through 26. BICC is the parent of more than 40 associated companies said to be the world's largest manufacturers of electric cable.

Pennsalt Enters Plastics Field With Polyvinylidene Fluoride Resin

Long a supplier of intermediates used by other plastics manufacturers, Pennsalt Chemicals Corp., Philadelphia, has officially entered the plastics field with a new polymer that is claimed to have high resistance to heat, light, and chemicals; superior mechanical strength and toughness; high thermal stability; as well as stability under strong ultraviolet radiation and extreme weather conditions. Electrical insulation applications and wire coatings are among the uses foreseen for the new polymer of vinylidene fluoride called RC-2525 resin. More details will be given in the May *New Products* column.

GT&E President Predicts Ten Year Doubling Of Electric Power and Manufacturing

According to Don C. Mitchell, president of General Telephone & Electronics Corp., the nation's consumption of electric power will rise to 1.5-trillion kilowatt hours by 1970 in contrast to about 700-billion in 1959. He also predicted that the electrical manufacturing industry will double its annual factory sales from the present total of about $25-billion.

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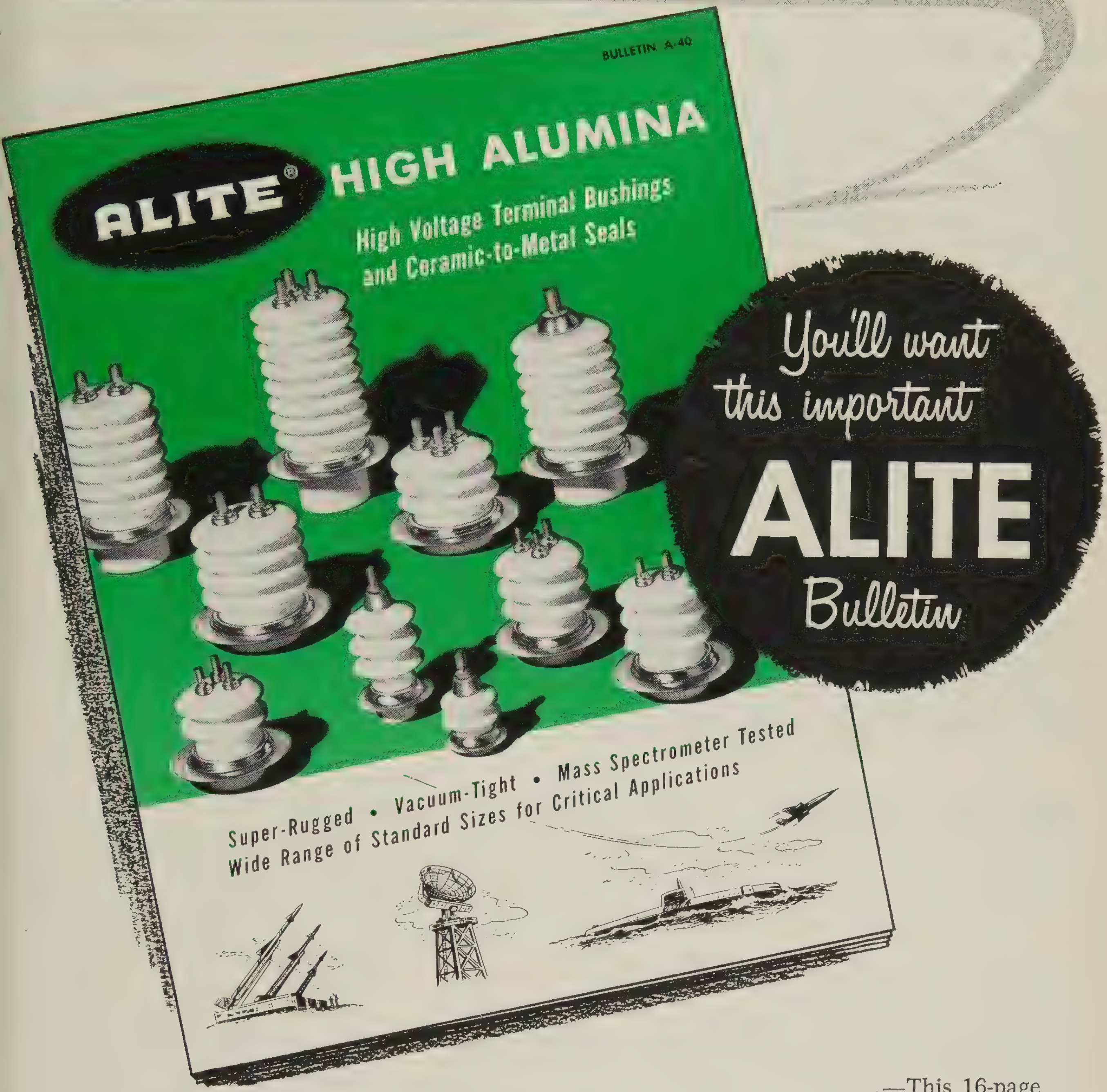
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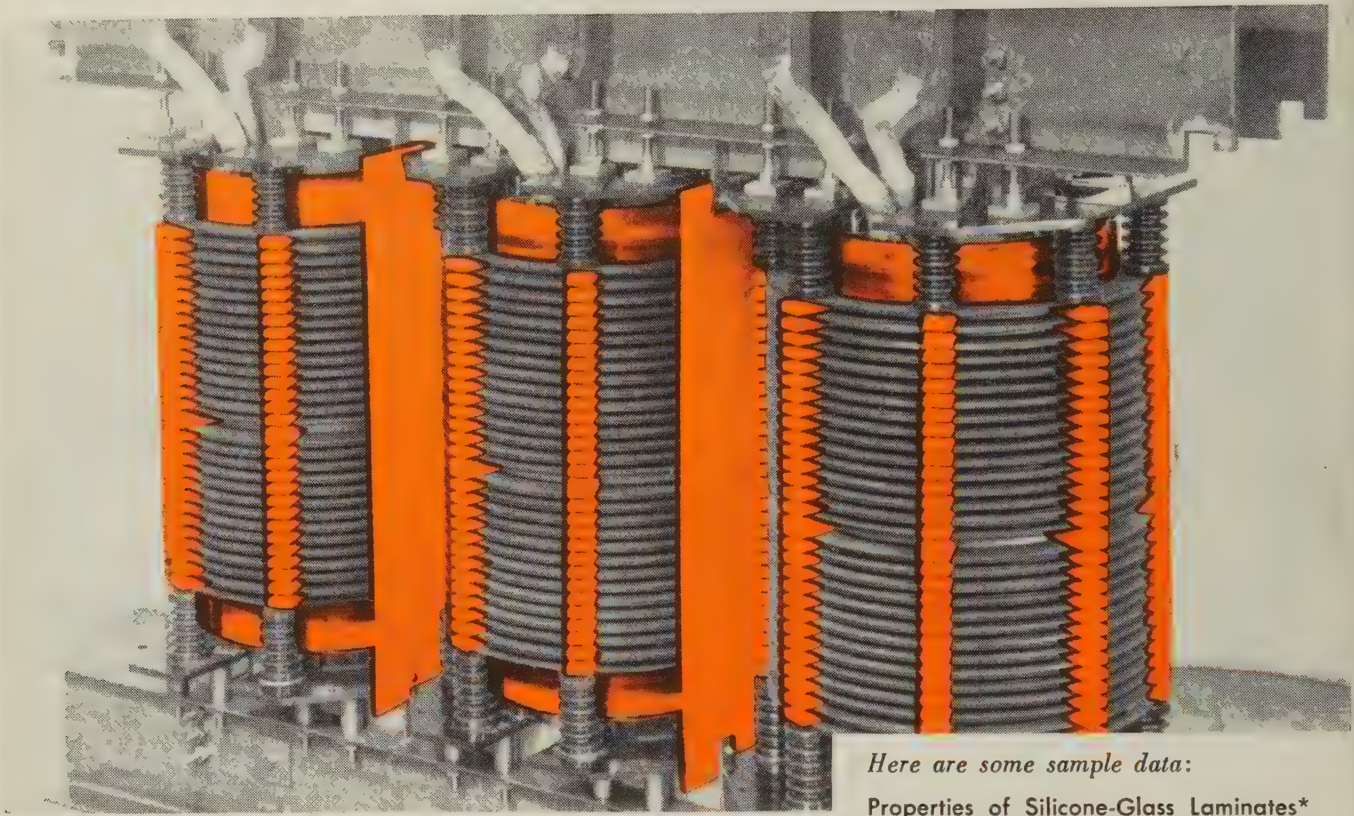

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Silicone Glass Laminates Help Make This Transformer Lightweight, Maintenance-Free

Insulating components made from silicone-glass laminates help improve the design and performance of electrical equipment. Bonded with heat stable Dow Corning silicone resins, glass laminates have high arc resistance, low loss factor, low moisture absorption . . . excellent mechanical and dielectric strength even after prolonged aging at 250 C.

When used with other silicone insulating components, silicone glass laminates are an integral part of transformer designs that permit lighter weight, smaller size, easier installation and maintenance than transformers using any other class of insulation.

And they are easy to fabricate . . . easy to apply. Silicone-glass laminates can be drilled and machined without shattering, sawed without splitting and sanded without melting . . . by using carbide tools, ordinary shop equipment and procedures.

Silicone glass laminates are widely used for spacer blocks, interphase barriers, and as core insulation in transformers; for slot wedges, coil dividers, and top sticks in motors; for parts, such as terminal boards and coil forms in other electrical equipment. Silicone glass laminates are supplied by leading laminators as tubes, sheets, punched or molded shapes. Write today for full information plus list of fabricators.

Here are some sample data:

Properties of Silicone-Glass Laminates*

Property	Range
Flexural strength, flatwise, psi, 1/8-inch thickness	
Lengthwise	20,000-40,000
Crosswise	18,000-33,000
Izod impact strength, edgewise, ft-lb per inch notch	
Lengthwise	6.5-17.0
Crosswise	5.5-14.0
Bonding strength, lbs., 1/2-inch thickness	
Condition A	650-1100
Condition D-48/50	550-950
Water Absorption, percent	0.05
Electric Strength, volts/mil	
Initial	310
After 200 hr at 260 C	327
After 5000 hr at 260 C	180
Dielectric Constant at 10^2 cycles	
Condition A[1]	3.70
Condition D[2]	3.85
Dissipation Factor at 10^2 cycles	
Condition A[1]	0.0024
Condition D[2]	0.0084
Arc resistance, seconds	
Condition A	180-292
Condition D-48/50	180-248
Volume resistivity, meg-cm.	
Condition C-96/35/90	1×10^4-4×10^7
Surface resistivity, megohms	
Condition C-96/35/90	10-10,000

* As measured on samples 1/8 inch thick

[1] As received

[2] After 24 hr immersion in water at 23 C

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Serviceable from —90 to 250 C, Silastic resists weathering, ozone, arcing, corona, moisture, most oils and chemicals. Lead wire, hookup wire, appliance wire, flexible heating wire, ignition cable, and control cable insulated with Silastic are available from leading wire manufacturers. List of wire manufacturers available upon request.

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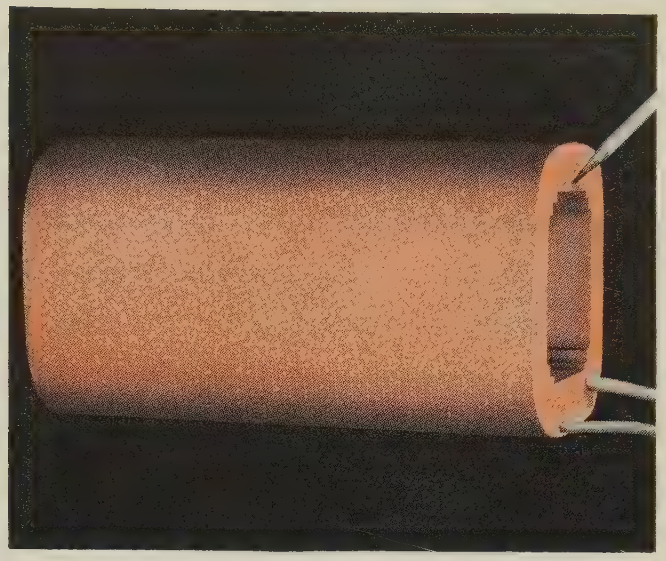

Solventless Silicone Resin "seals in" Performance

Potted in solventless silicone resin to which zirconium orthosilicate has been added as a filler, this induction heating coil is completely protected against high heat or high humidity. This resin and filler will withstand even molten metal without deteriorating . . . and is competitive in cost with many other encapsulating materials.

Dow Corning solventless silicone resin is ideal for impregnating or encapsulating motors, transformers and other electrical assemblies. It flows easily and cures to a solid, bubble-free mass. Able to withstand continuous service at 400 F and intermittent exposure to even higher temperatures, it has excellent dielectric properties and good thermal conductivity.

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Silicone Varnish Provides Heat Stability in Nuclear Power Valves

Exposed to radiation and the severe corrosive action of hot distilled water, electrically activated valves produced by Automatic Switch Company, Florham Park, New Jersey, get extremely hot in service. Continuous temperatures as high as 650 F and pressures up to 3,000 psi are encountered. Cooling fins dissipate only some of the heat.

The unit's coils are insulated throughout with Dow Corning silicone components and dipped in silicone varnish to produce a moisture-resistant insulation system of high dielectric strength. Over 100 units already in service in atomic submarines, surface vessels and power plants underscore the exceptional heat stability that can be achieved with silicone insulation and Asco's control valves.

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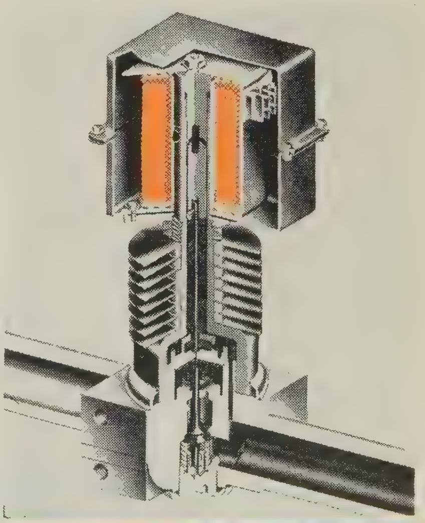

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A NEW CLASS B INSULATION HAS RESILIENT WEAVE AND HIGH DIELECTRIC STRENGTH UNDER STRETCH

Natvar Teraglas is a new flexible insulating material comprising a base fabric, woven from polyester (polyethylene terephthalate, or "Dacron") warp yarns and continuous filament glass filler yarns, coated with an improved varnish, possessing exceptional dielectric strength under elongation. It will withstand Class B (130°C) operating temperatures.

In view of the higher dielectric strength of Natvar Teraglas compared to bias varnished cambric, thinner sections or fewer layers may be used to provide the voltage breakdown protection desired. Consequently, at comparable tape prices, a significant saving may be realized in production costs, while permitting up-grading to Class B (130°C) temperatures.

Natvar Teraglas is available in two thicknesses, .010" and .012"—in tapes, in full width rolls (36"), or in sheets. Ask for Data Sheet and Samples.

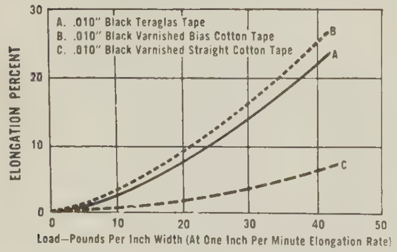
Natvar Teraglas will prove advantageous in many applications — for insulating motors, generators, transformers, cables, switchgear, busbars, and other apparatus and equipment where resiliency and high dielectric strength are desirable.

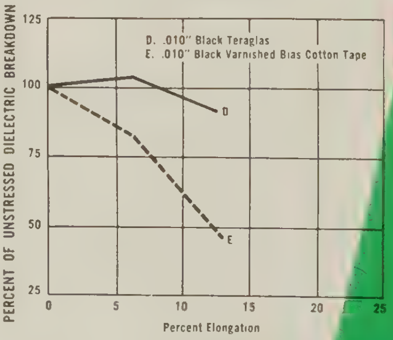
TYPICAL DATA

Physical Properties:		**.010"**	**.012"**
Approximate weight per sq. yd., lbs.		0.54	.62
Breaking Strength lbs./in. width,	Warp Filler	45 100	45 100
Tear Strength, grams	Warp Filler	Over 1000 Over 1000	Over 1000 Over 1000
Elongation, % (Under 25 lbs./in. width—3 minutes)		7.5	7.5

Electrical Properties:	**.010"**	**.012"**
Electric Breakdown Strength (C48-23-50 V/M)	1600	1600
Electric Breakdown Strength (Under 6% stretch)	1600	1600
Electric Breakdown Strength (Under 12% Stretch)	1450	1450
Power Factor, %, at 80° C-50 V/M-60 c.p.s.	2.5	2.5

LOAD-ELONGATION CHARACTERISTICS FOR NATVAR BLACK TERAGLAS





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- Teraglas**
- Isoglas® sheet and tape
- Isolastane® sheet, tape, tubing and sleeving
- Vinyl coated and silicone rubber coated Fiberglas tubing and sleeving
- Extruded vinyl tubing and tape
- Styroflex® flexible polystyrene tape
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Insulation Forum

This regular monthly feature is built around a timely question concerning the electrical insulation field. Your suggestions for future questions and participation are invited. This month's question is:

What is your opinion regarding he establishment of a cooperative esting laboratory which would certify test data on insulation materials . . . and which could also make its facilities available for insulation material and application evaluation and research?

Edward Gold

Chief Chemist, National Presto Industries Inc., Eau Claire, Wisc.

"The safeguarding of a reputation for producing high quality consumer goods is a constant goal for progressive companies. The maintenance of consistently high quality products requires the best efforts of raw material vendors and of the product manufacturers if consumers are to be offered first rate merchandise. In electrical appliances, one major key to long-lived performance lies in the quality of the insulation materials.

"The establishment of a cooperative testing laboratory in the field of insulation could greatly facilitate the development of high standards of performance for such materials. In addition to evaluating new materials and working out specifications, standards, and test procedures for them, such a laboratory would be in an excellent position to conduct research in the development and utilization of new basic materials. Such a laboratory could provide referee tests when the results of other laboratories or the interpretation of those results might be in dispute. In addition, such a laboratory might also help to act as an information exchange on the subject of insulation. It could collect, consolidate, abstract, and index information and make it readily available to personnel in industry, government, and education.

"Such a program by a cooperative testing laboratory would be of particular benefit to smaller companies who do not have the financial resources to undertake comprehensive research and evaluation programs. It would also tend to sharply reduce the present time lag between the discovery of a new material and its commercial utilization.

"One last note—In this rapidly shrinking world, the need for cooperation across national boundaries becomes more and more a prerequisite for human survival. Since science knows no borders and scientific truths are universal, the establishment of such a cooperative laboratory might best be international in scope, perhaps under the jurisdiction of a United Nations agency.

C. L. Christiansen

Regional Supervisor, Dow Corning Corp., Englewood Cliffs, N.J.

"There is no question in my mind that the insulation industry has needed such a cooperative testing laboratory for a long time. This industry generally has a few large corporations—however there are many smaller corporations who do not have the facilities or the financial background to install laboratories of sufficient size to properly or thoroughly test their own products. If all of the people in the insulation manufacturing industry would cooperate and put up a small amount of money a laboratory could be built and operated so that it would cost no one a great deal.

"A start on this has already been made. There is an opportunity for the industry to cooperate with a research and development center to be built in Florida which will be staffed by qualified laboratory people working on a part time basis after their retirement, and assisted by newly graduated

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people who will be based at the laboratory for experience and practical training. May I suggest any interested parties direct a letter to the Golden Years Research and Development Center, Ridgemanor, Florida."

E. B. Snyder

Vice President and Chief Engineer, Bentley, Harris Manufacturing Co., Conshohocken, Pa.

"There is a crying need for a cooperative testing laboratory of this type in an industry such as ours, which includes a large number of small companies. The many items of information that should be available on all types of insulating material require many pieces of expensive equipment, provision of all of which is beyond the budget ability of the majority of small manufacturers.

"The laboratory's facilities would also be useful in the evaluation of insulation systems and materials for special applications. These activities frequently tax the laboratory facilities of the small companies beyond the level for which they are equipped.

"There might be some question as to the usefulness of such a laboratory in basic research, since most companies will prefer to undertake this activity themselves in order to gain the maximum competitive advantage."

J. E. Fenn

Sales Manager, Tape Div., Plymouth Rubber Co. Inc., Canton, Mass.

"The establishment of a cooperative testing laboratory has been discussed for a number of years and, under certain qualifications, would be a worthwhile project. This contemplated cooperative testing laboratory would fill a needed place in the insulation industry by making itself available for some of the following projects:

"It would work toward the creation of uniformity of specifications between OEM, electrical utilities, and

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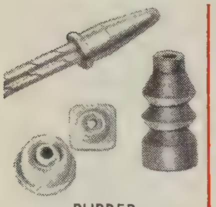

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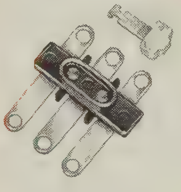

PLASTICS

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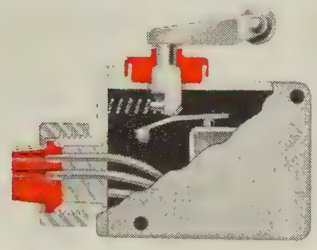
Mass production of precision parts ranging from phase lead insulating caps of silicone rubber (shown at far left designed for room temperature vulcanizing) to switch parts of mineral-filled silicone resin (lower right, designed to retain dimensional stability at temperatures of 2000° F.) calls for precision production techniques gained only through experience.



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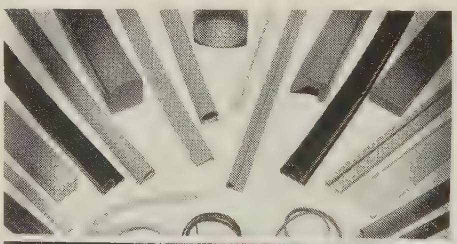

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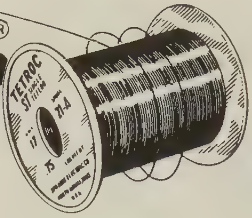

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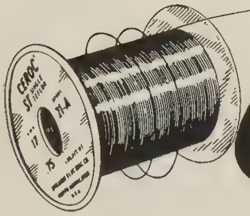

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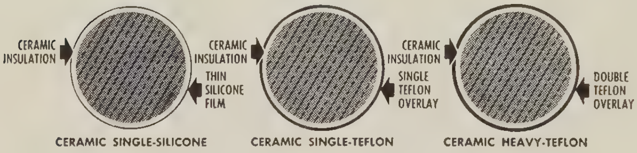

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transportation systems as well as the Federal Government. There is, at this time in many parts of the insulation industry, a vast discrepancy between the specification requirements of various users and varying degrees of quality demands on the part of each.

"This testing laboratory might be the basis for the establishment of uniform test methods on similar types of insulating materials which would be of great help throughout the industry.

"It has been suggested that a cooperative testing laboratory might actually make a periodic test on production materials toward the end of certifying and qualifying particular brands on a quality basis. Ideally, this cooperative testing laboratory might act as the Underwriters Laboratories now works in the broad field of safety devices but specifically limit itself to insulation materials.

"I honestly do not feel that such a laboratory would have much value to the industry for application evaluation and research. Most manufacturers have their own facilities available and undoubtedly would be reluctant to participate in cooperative research where developments might be discussed rather freely."

Leo C. Cunniff

Vice President, Industrial Instruments Inc., Cedar Grove, N.J.

"A laboratory set-up by a group of suppliers and/or users of electrical insulation would undoubtedly be valuable for certification of test data. If a company were engaged in full time research and evaluation work, I think there would be some doubt as to the value of such a laboratory, since the convenience and time savings would probably warrant the expenditure required to provide its own insulation test facilities. For small companies and those not having enough work to require full time use of such facilities, however, the idea would be an attractive one."

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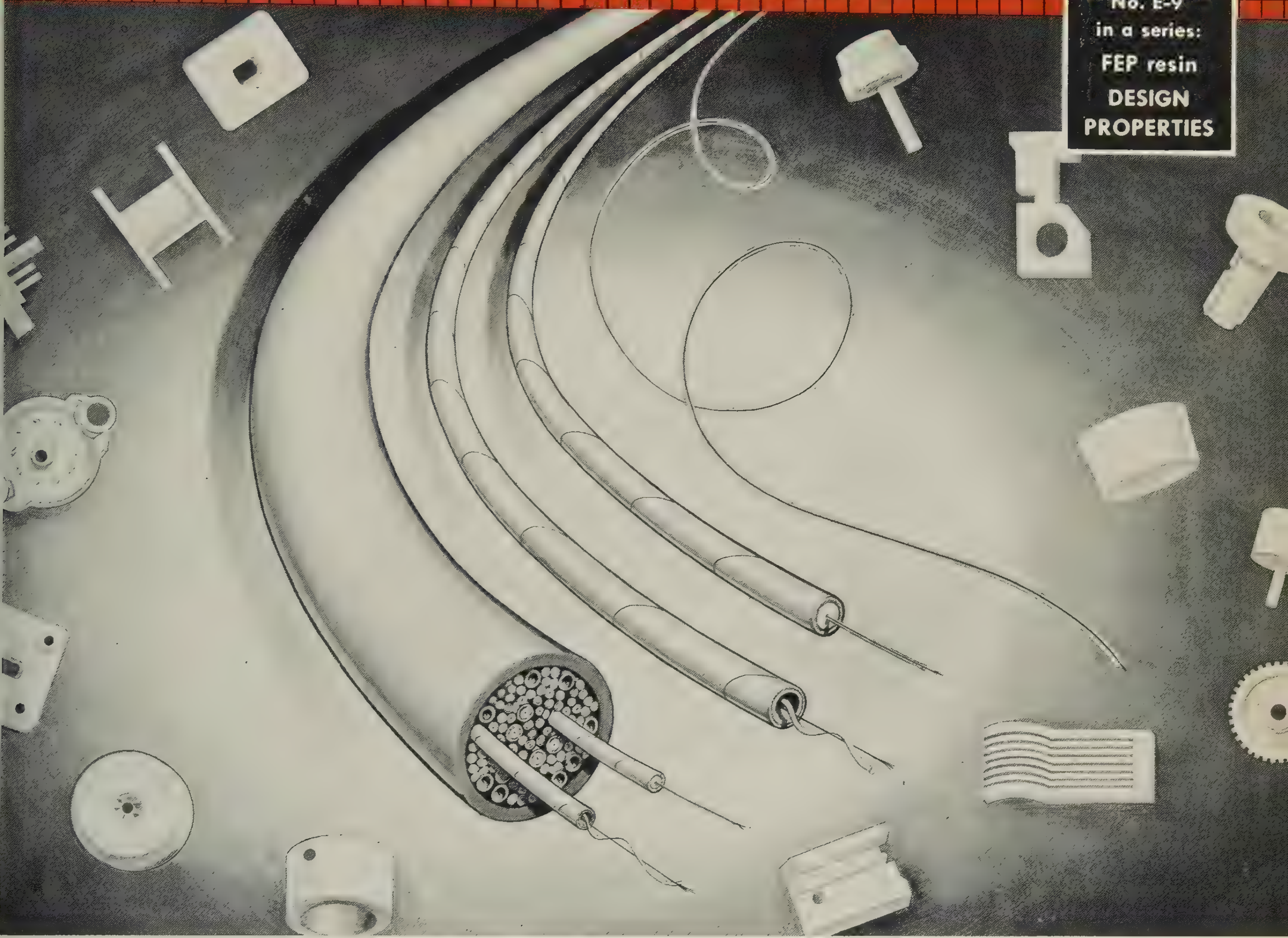

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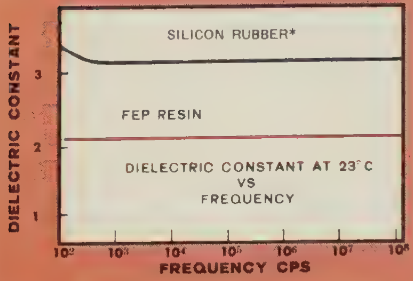
And because TEFLON 100 FEP resin is melt-processible, it can be extruded as jackets for wire and cable . . . as long, continuous lengths of wire insulation . . . and rapidly fabricated into complex shapes.

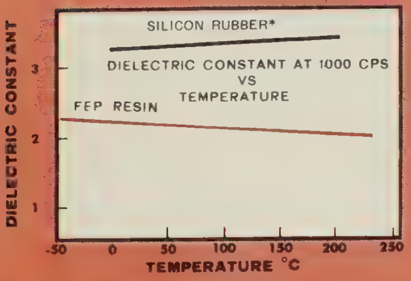
On the following page, you will find more information on the electrical, mechanical and thermal properties of TEFLON 100 FEP resin, plus examples of the improved designs now made possible by this new addition to the family of TEFLON resins.

TEFLON is Du Pont's registered trademark for its family of fluorocarbon resins, including TFE (tetrafluoroethylene) resins and FEP (fluorinated ethylene propylene) resin.

OVER

Now . . . melt-processible FEP resin for jacketing . . . extrudable wire insulation . . . complex shapes





*TYPICAL LOW MOISTURE ABSORBTION COMPOUNDS

Table 1. Thermal properties (typical values)

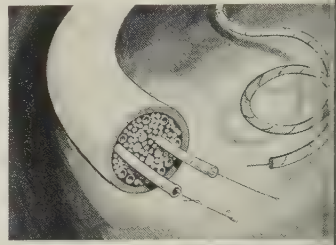
Property	FEP Resin
Melt point, °F.	545-565
Cut-through temperature, °F. (32-mil wire, 8-10 mil film, 340 gm. load)	522
Low-temperature brittleness, °F. (ASTM D746)	−140
Coefficient of linear thermal expansion, −100°F. to +160°F., in./in./°F.	4.6-5.9 x 10^{-5}

Table 2. Mechanical properties

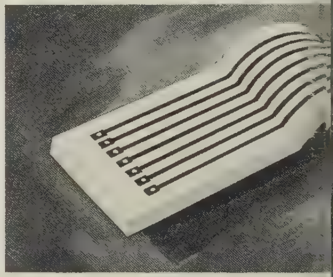
Property	FEP Resin
Coefficient of Friction	
Inclined plane against steel, 77°F.	0.09
Tensile Strength, lb./sq.in.	
−321°F.	16,000
73°F.	3,080
392°F.	650
Elongation, %	
−321°F.	4-5%
73°F.	250-330%
392°F.	200-250%
Flexural Modulus, lb./sq.in.	
73°F.	50,000-60,000
392°F.	6,000-8,000
Cold Mandrel Bend	
MIL-W-16878C (−85°F.)	passes

The exceptionally low dielectric constant of TEFLON 100 FEP resin over a wide range of frequencies and over a wide range of temperatures is shown in the charts at left. The dissipation factor of FEP resin is less than 0.0003 at 100 cycles, to a maximum of 0.0007 at 1 megacycle. These outstanding insulating properties are not affected by heat aging.

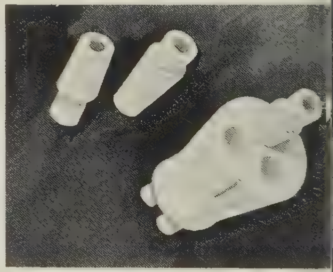
The tables at left illustrate typical values of thermal properties of TEFLON FEP resin and the excellent mechanical properties offered by this resin.



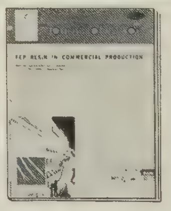
Cable jacketing of FEP resin offers the outstanding insulating properties of this resin, plus mechanical toughness, abrasion resistance and smooth-sliding qualities. It is economical to make because FEP resin is easily extruded, at temperatures that do not affect primary insulation. Long, continuous lengths of insulation for hook-up wire are also easily fabricated.



Because FEP resin is heat bondable to itself and to many other materials, including TFE resins and copper, it now makes possible improved design of printed circuits, both flexible and rigid. Film of FEP resin is an excellent cement for bonding copper to TFE resins and other materials because laminates so bonded will have the excellent surface electrical properties of the FEP resin plus the special properties — such as rigidity or economy — of the base material. And both the dielectric constant and dissipation factor of FEP and TFE resins are essentially invariant over wide ranges of temperature and frequency.



A variety of tiny electronic components such as feed-throughs, stand-offs, tube and diode sockets, and terminations like the missile connector right, utilize the dielectric properties of TEFLON FEP-fluorocarbon resin. Over a measured temperature range from −40°F. to 400°F., its volume resistivity exceeds 10^{18} ohm-cm, and its surface resistivity exceeds 10^{14} ohms/sq., over the widest range of frequencies. Complex shapes are readily injection-molded in one piece.



Have you seen Volume 1, No. 1, of the new "Journal of TEFLON"? This regular publication contains articles of interest to all users and designers of electrical components, wire and cable. Put yourself on the mailing list for this up-to-date, informative journal. Simply write to the address below.

FOR MORE INFORMATION . . . about the properties and applications of TEFLON fluorocarbon resins—in particular, the new FEP resin—just drop us a line, mentioning your area of interest. Address: E. I. du Pont de Nemours & Co. (Inc.), Polychemicals Department T-224, Room 2526, Wilmington 98, Delaware. **IN CANADA:** Du Pont of Canada Ltd., P.O. Box 660, Montreal, Que.

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BETTER THINGS FOR BETTER LIVING . . . THROUGH CHEMISTRY

Performance of Silver Contacts In Atmospheres Containing Silicone Vapors

By L. E. Moberly, Insulation Department, Westinghouse Electric Corp. Research Laboratories, Pittsburgh, Pa.

Introduction

With the increasing demands for high temperature materials, it is natural that the silicones, whose retention of properties at high temperatures is well known, should be applied in many new equipment and apparatus designs. Only a few types of silicone materials, such as sealing compounds, elastomers, lubricants, and electrical insulation, need to be considered to realize that various types of contacts will frequently be called upon to operate in applications in which silicones are next-door neighbors.

Evidence that malperformance of silver contacts may occur in atmospheres containing vapors distilled from typical silicone materials is shown in this article. Since other types of contacts very probably will be similarly affected, this appears to be a worthwhile point for consideration in the design of devices involving electrical contacts.

Silicone Materials and Sliding Contacts

The fact that silicone vapors affect the performance of contacts has been recognized for some time.(1,2,3) This effect was originally found in sliding contacts when carbon brushes were applied on totally enclosed, silicone insulated, d-c machines. The principal difficulty noted was that brush wear became rather highly accelerated, although upset commutation was an additional observation in many cases. More recently, it has been possible to produce successful designs "around this problem" through the application of special brush grades, proper selection of silicone types, and optimum precuring of the silicone insulation. However, the effect on brush wear still represents a limiting factor in the use of silicone materials.

One of the outstanding characteristics of silicone materials as a class is their good thermal stability. Even so, at the higher temperatures where their application is justified (temperatures in the range of 150°C–250°C) weight loss occurs depending to some degree on the particular silicone polymer. Further, it has been noted that most of these materials continue to slowly lose weight even after long periods of heating. Accumulative weight losses over long heating periods at 250°C in air for a group of typical silicone polymers are shown in figure 1.(4) Scala, Hickam and Loeffler, in degradation studies on silicone materials, have shown that the greatest fraction of the weight lost consists of low molecular weight silicone oils along with small amounts of water, carbon dioxide, carbon monoxide, hydrogen, and light organic compounds. This oil, consisting of relatively low molecular weight silicone fragments, becomes adsorbed on contact surfaces. Subsequent electrical breakdown through these insulating films causes further degradation of the silicone molecule leaving a firmly attached abrasive residue. On sliding contacts this residue abrades the brush face resulting in unusually high wear rates.

Thermostat Contacts

On the basis of the experience with the silicone effect on sliding contacts it appeared to be a likely possibility that some sort of disturbance could be anticipated in the performance of other types of contacts operating in atmospheres containing silicone vapors. The work with sliding contacts indicated that insulating material was

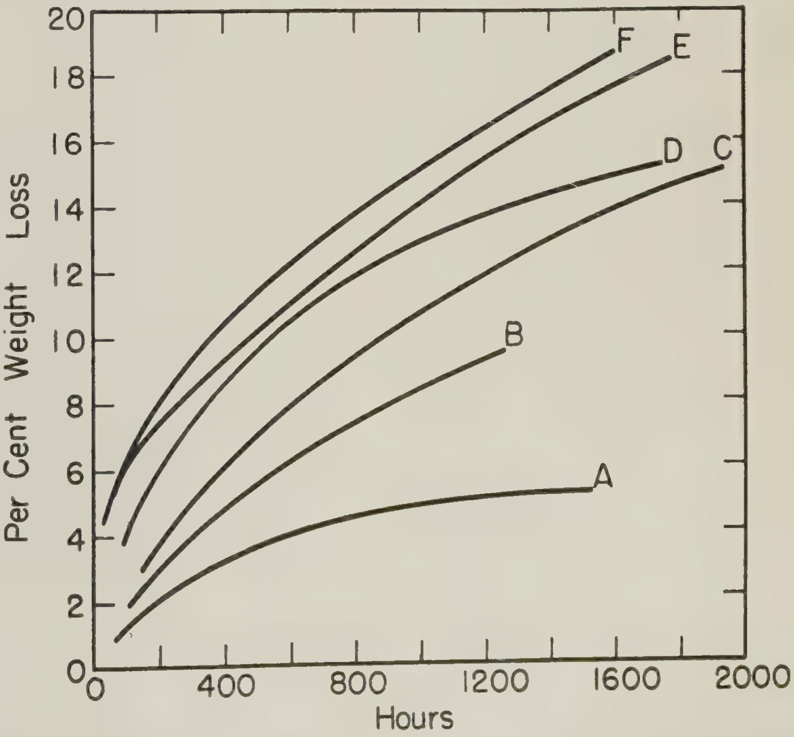

Figure 1, weight lost from silicone materials heated in air at 250°C.

NOTE: This article is an edited version of a paper previously presented orally at the 1959 Engineering Seminar on Electrical Contacts at Pennsylvania State University.

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being transferred onto contacting surfaces. This certainly would not be considered good practice in the application of any type of electrical contact.

The contacts we chose to study were of the type which are used quite commonly in thermostats for controlling the temperature of resistance heating devices. The actual contact elements were fine silver buttons whose diameter was ¼ inch.

Figure 2 shows the apparatus used for our tests. The thermostat was mounted on a brass disc B so the contacts C were one above the other. The brass disc rested on a hot plate whose resistance element was connected in series with the thermostat. The lower contact of the thermostat had a rounded surface while the surface of the upper contact was flat. A bimetal arm D raised or lowered the upper, moving contact to open or close the heating circuit. The brass disc contained a well E in which cured silicone materials could be placed for testing. The brass disc and thermostat assembly was covered by an inverted glass vessel F which provided a semi-enclosed compartment. The temperature of the brass disc, which was controlled by the thermostat, was measured and continuously recorded by a thermocouple embedded in the disc.

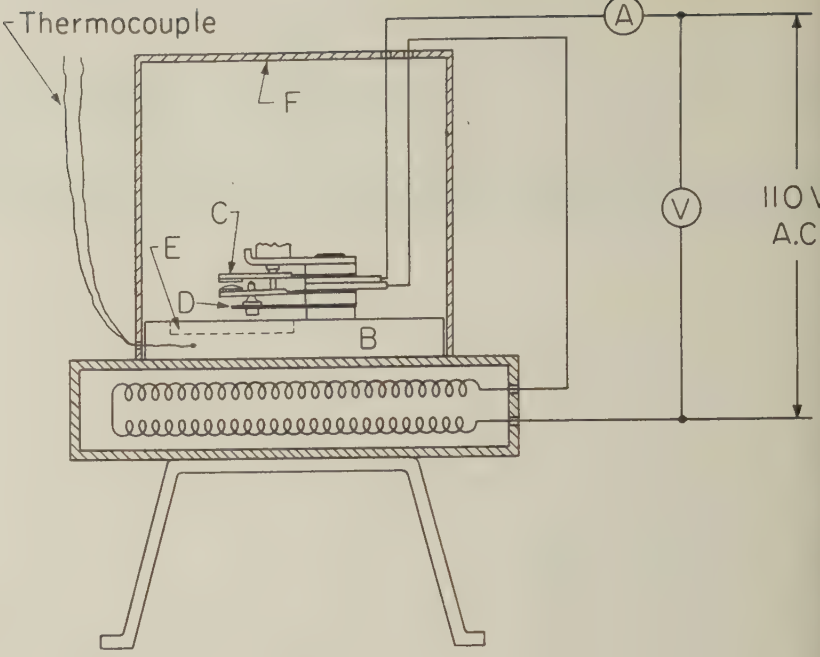


Figure 2, apparatus used for tests.

The circuit involved was very simple, consisting essentially of the resistance element of the hot plate in series with the thermostat connected across the 110 v a-c line. A voltmeter and an ammeter for measuring line voltage and current through the system completed the circuit. The resistance of the hot plate heating element was 12.5 ohms which resulted in a current flow of approximately 9 amperes through the contacts.

By adjustment of the thermostat the temperature of the brass disc was controlled at a mean temperature of 200°C for all tests. Actually the temperature cycled as the thermostat opened and closed the circuit. Since the test set-up was not especially designed for sensitive control, the cycles covered a fairly wide range of temperature. Cycles occurred at a frequency of about 16 per hour. All tests were run for an approximate total of 2500 cycles.

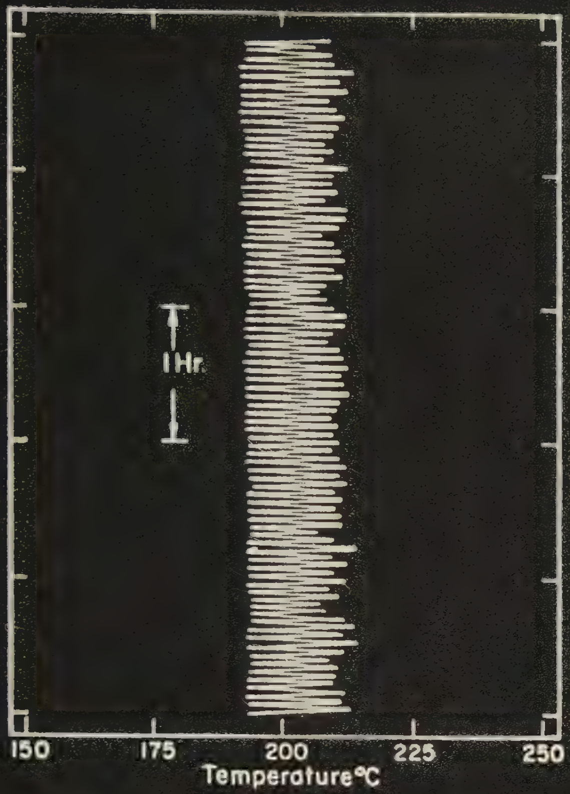
Test Results

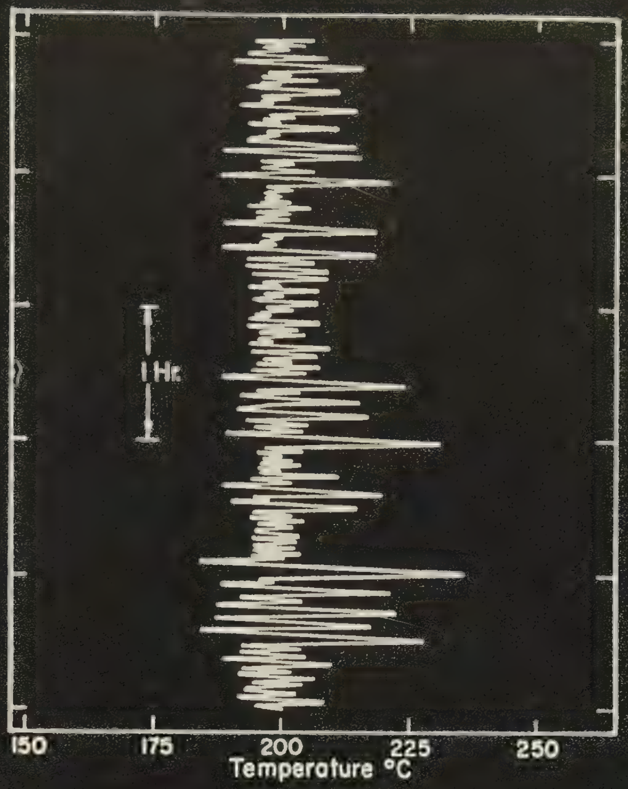
Figure 3 shows a typical series of cycles obtained when no silicone was present in the glass enclosure. The temperature range covered is approximately 190-210°C. The closing of the contact was always accompanied by a short arc. Apparently, as the contacts were slowly brought together a point was reached at which conduction was initiated in an arc across a very short gap. This caused a fusion of metal and the formation of a metal bridge. The arc was then extinguished and, as the temperature dropped, the metal of the bridge solidified to produce a weld between the contacts.

In figure 3 it is noted that some variation occurs in the maximum temperature reached from cycle to cycle, amounting to about 8°C. Although small fluctuations in line volt- factor to this spread in temperature, age may have been a contributing it is felt that the height of the temperature peaks may be an indication of the strength of the weld produced on that particular contact make. The stronger the weld the greater the difficulty involved in opening the contact. Thus when strong welds were produced, the current flowed for a longer period than when weak welds were formed resulting in a higher temperature in the brass disc. An arc of short duration also always occurred upon breaking the weld and separation of the contacts.

The minimum temperature occurring in the cycles is shown to vary also, but to a much lesser degree. This variation can be attributed to the roughness which develops on the contact surfaces. Arc erosion and breaking of welds causes material transfer and results in the formation of peaks and pits. Then, depending on how these line up when the contacts are brought together, electrical contact will be established at a higher or a lower temperature.

Figure 4 shows a series of temperature cycles for a thermostat operating in an atmosphere contaminated with vapors from a cured silicone sealing compound. This is a portion of the temperature curve obtained after about 2000 cycles operation. Under these conditions much wider fluctuations occur in both the maximum and minimum temperatures. The average temperature range covered by the cycles is narrower indicating that the average strength of the welds formed is lower. Low strength welds are probably due to the presence of foreign materials, i.e., the decomposition products of silicone compounds, blended with the contact metal. The presence of several high peaks shows





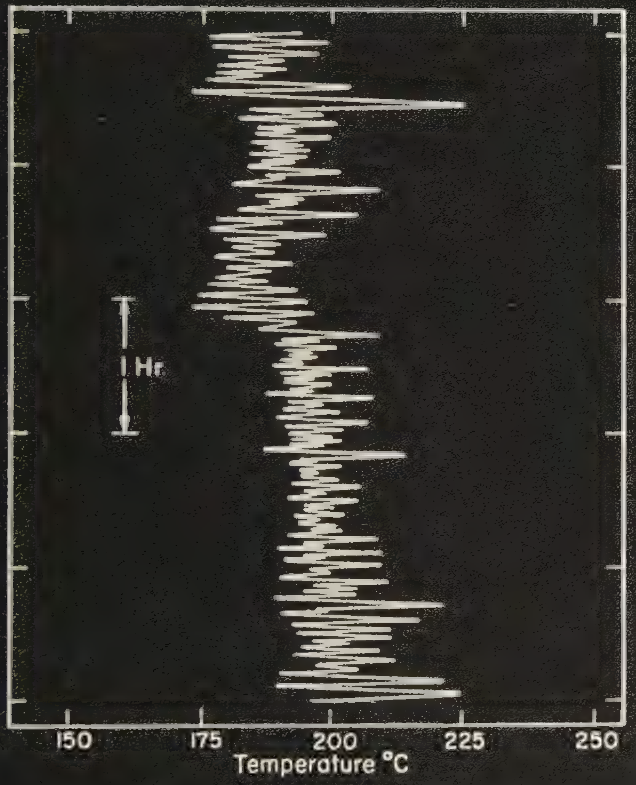


Figure 3, upper left, typical temperature cycles obtained with noncontaminated contacts.

Figure 4, upper right, temperature cycles obtained after 2000 cycles operation in silicone contamination.

Figure 5, lower left, temperature cycles obtained after 2250 cycles in silicone contamination.

hat unusually strong welds are oc-asionally formed. Later observations how that the surface roughness is reatly increased in the silicone con-aminated atmosphere. As pointed out above, this can account for much of the variation at the low temperature end of the cycle. In addition, uncertain contact made as a result of the presence of insulating material on the contact surfaces contributes to this erratic behavior. It was mentioned that an arc occurred each time contact was made or broken. Under noncontaminated conditions, this con-

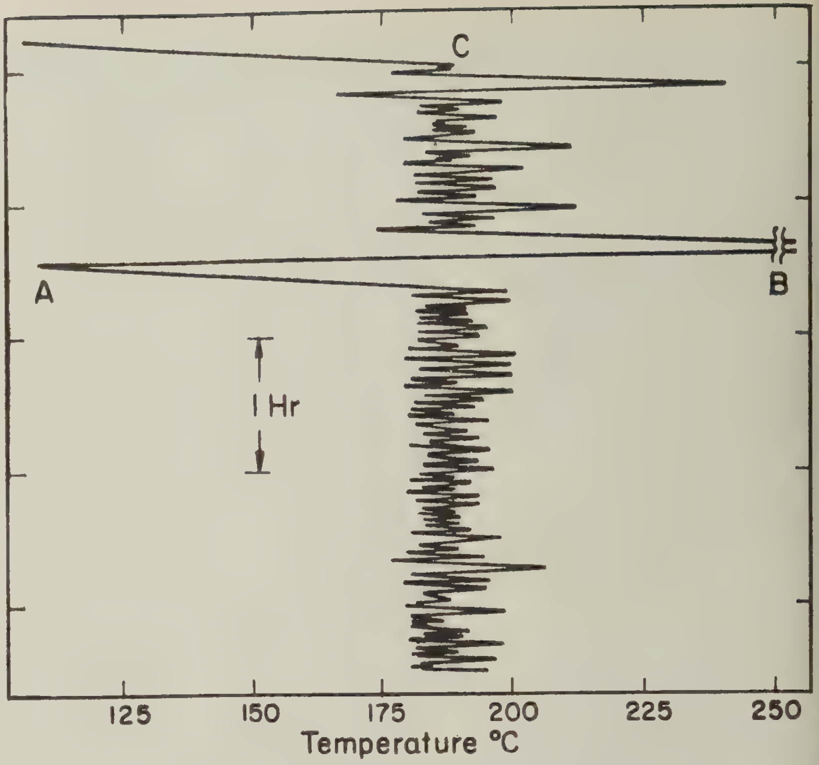


Figure 6, temperature cycles showing failure of contact after 2400 cycles in silicone contaminations.

sisted of a single sharp arc. When silicone was present, the arcing was somewhat erratic in apparent intensity and at times more than a single arc occurred during the contact make. This was additional evidence that difficulty was encountered in establishing electrical contact due to the presence of the insulating material.

Figure 5 shows cycles of the type obtained after about 2250 cycles of operation. An actual shifting in the control temperature level occurred, presumably due to the increased roughness of the contact surface and a shifting of points of contact. Eight hours later, after approximately 2400 cycles, the contact failed.

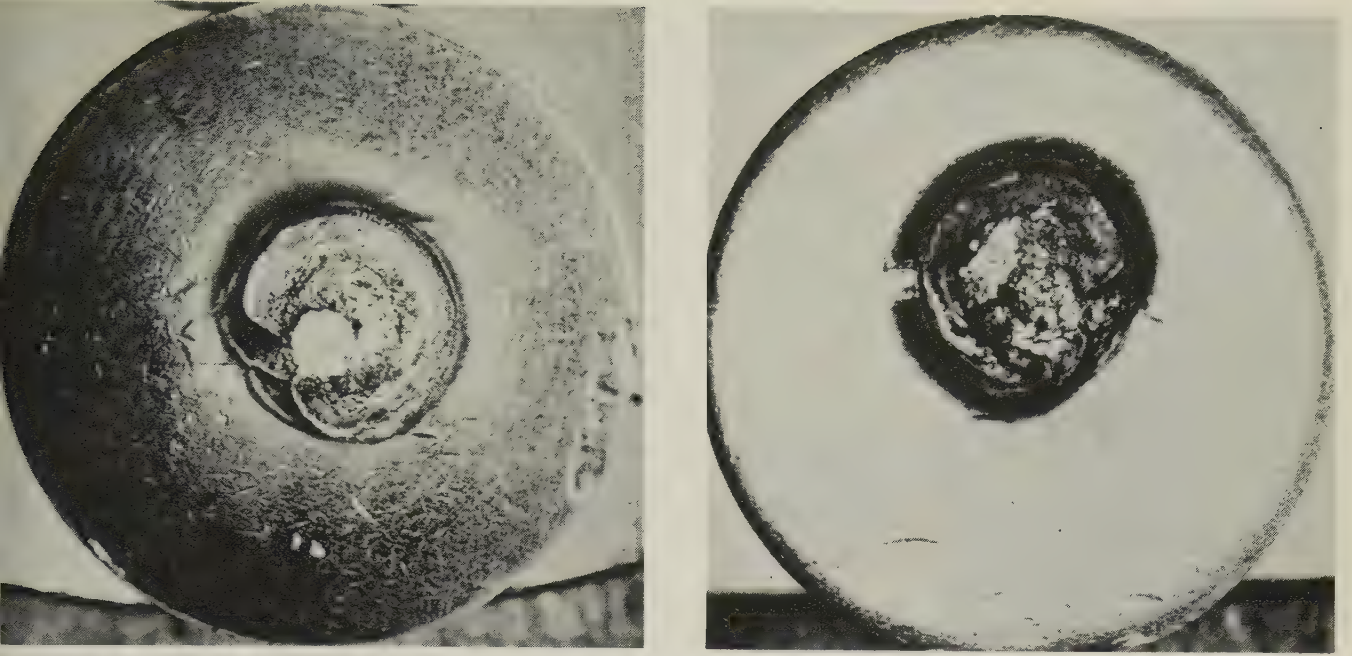
Two types of possible failure were demonstrated within the latter part of this period (figure 6). At the cycle designated as A, electrical contact failed to make until the temperature had cooled to 85°C even though the contacts were pressed together by the action of the bimetal arm. Apparently the points on the contact surfaces which were making physical contact were covered by a highly insulating coating. Forces produced by the cooling of the bimetal arm finally became high enough to cause this insulation to break through and electrical contact was made at 85°C. When electrical contact was eventually made, the contacts became stuck together so firmly that they could not be separated by the bimetal even though the temperature rose well above the control temperature. This represents one type of contact failure which may occur in silicone vapor contaminated atmosphere. Apparently the siliceous, glassy residue left on the contact surfaces by the decomposition of the silicone deposit became fused at the arc temperature and, along with the contact metal, formed an unusually strong weld between the contacts.

Actually the circuit was opened by an auxiliary safety device at point B after the temperature had risen to 275°C. Otherwise, burn-out of the heating element would probably have occurred. During the subsequent cooling the bond holding the two contacts together became broken allowing them to separate. The thermostat again operated erratically for several more cycles. Finally, at point C, the thermostat contacts become insulated and remained isolated even though the temperature dropped to the room value. This represents the second type of contact failure which can be caused by the insulating vapors from silicone materials.

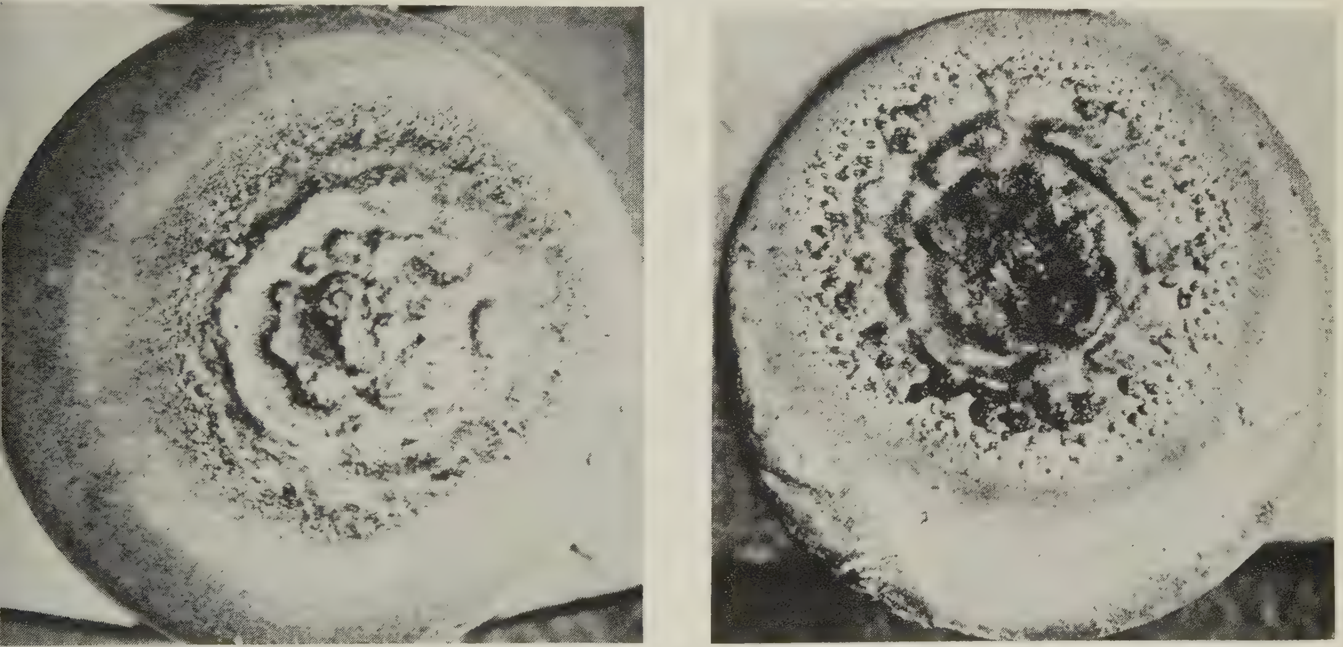
Microscopic Examination

Following the 2500 cycle tests the surfaces of the contacts were examined microscopically. Figures 7 and 7A show the lower and upper contacts, respectively, of a thermostat which operated under clean, noncontaminated atmospheric conditions. The temperature cycles which were shown on figure 3 were obtained with these contacts. The photographs show that a relatively small part of the total button area has been involved in the contact operation. This is an indication of the small amount of contact erosion which has taken place. Due to the arcing, welding, and breaking of welds, a certain amount of pitting has occurred on the surfaces. However, these pits are very small and result in a satiny texture in the actual contact area. This area is surrounded by a ring of black, powdery deposit which appears to be a part of the metal which was vaporized in the arc and became oxidized as it cooled and was deposited just outside the contact ring. The fact that no material has been transferred beyond this area is an indication that the arcs which occurred were relatively mild.

Figures 8 and 8A are the lower and upper contacts of a thermostat which operated in the presence of vapors from a cured silicone sealing compound. This is the thermostat which finally failed as shown in figure 6. Several obvious differences between these contacts and those in figures 7 and 7A exist. The portion of the button affected by the contact operation is considerably greater. Discoloration has taken place over almost the entire button surface. It is somewhat surprising that no black ring of silver oxide is present. We feel this may be due to the formation of a glass film over the silver particles which are vaporized in the arc. This glassy residue which is produced from the silicone compounds adsorbed on the contact surface excluded ozone from the metal during the cooling period preventing oxide formation. The surfaces in the contact spot have developed a



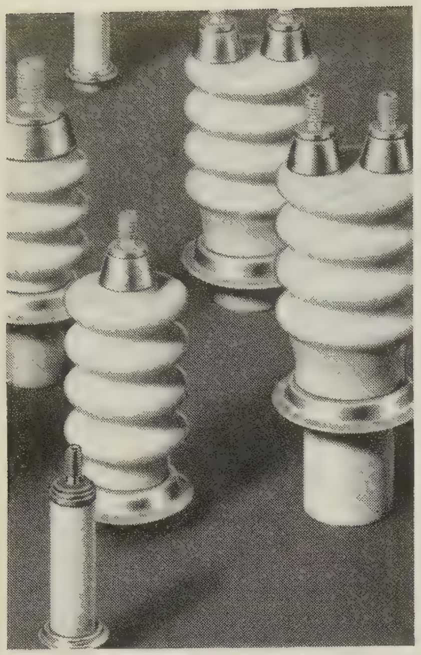
Figures 7 (left) and 7A (right), lower and upper contacts, respectively, of thermostat which operated under clean, noncontaminated atmospheric conditions.



Figures 8 (left) and 8A (right), lower and upper contacts, respectively, of a thermostat which operated in the presence of vapors from a cured silicone sealing compound.

glazed appearance suggesting the presence of a thin glassy film over much of the area. Due to the insulating film, electrical conduction must be made through smaller areas than for noncontaminated contacts. This results in higher localized temperatures and a greater vaporization and transfer of contact material. The contact areas are much more severely eroded and pitted in the presence of silicone.

Just outside the crater rim there are a large number of beads which project above the contact surface. These appear to be mixtures of silver metal and a glassy material. With close examination it is possible to find clear, glass-like bubbles apparently produced by fusion of the siliceous residue from the decomposed silicone compounds. It is possible that projections of this type were responsible for preventing electrical contact from being made in the final failure of this thermostat. Outside the bead covered area, the contact surface is covered by a tightly adherent, amber-colored film. This deposit resembles a thin varnish film and obviously is made up of the silicone materials which have been vaporized from the sealing compound. These materials, vaporized as light oils, are apparently polymerized by catalytic action of the contact surface or by partial oxidation to produce



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the adherent varnish-like insulating film.

The contact surfaces were examined spectrographically to confirm that silicon containing residues were present on the affected contacts. Contacts which failed when operated in the presence of silicone sealing compound showed a significantly high amount of silicon on their surfaces. Similar surface analysis of the contacts which had operated for an equivalent period in the absence of silicone materials showed no detectable silicon. This absence of silicon was also found on clean, unused thermostat contacts.

Discussion

It is generally preferred that all types of atmospheric contamination be eliminated in the operation of electric contacts. In actual practice, however, certain types and degrees of contamination may be tolerated depending to some extent on the particular contact application. "Brown deposits," apparently originating from the polymerization of adsorbed organic vapors, have been observed on noble metal contacts (6), particularly those utilized in low voltage, low current applications. The organo-silicon vapors which we have studied appear to produce films similar to these "brown deposits." A rather important difference does exist, however, which makes contacts particularly sensitive to the presence of silicone vapors.

In the case of switching contacts where arcing may be present it is quite likely that the organic materials making up "brown deposits" will either be vaporized or decomposed to a conducting carbon residue. This carbon residue is fairly easily oxidized to a volatile product. Thus it appears that the danger of building up appreciably heavy, insulating organic deposits on arcing contacts will be minimized.

The situation is quite different when silicone films become deposited on the contact surfaces. In the first place, the silicone polymers are more thermally stable than the comparable organic deposits and therefore will not be readily vaporized once they are adsorbed. More important, their decomposition products which result from the arcing are glassy, siliceous, refractory materials. Thus once these products are formed, they will persistently remain on the contact surface and continue to build up an insulating deposit. Even relatively low concentrations of silicone contamination may eventually lead to poor contact performance due to this accumulating tendency.

No attempt has been made to determine the contamination level which may be troublesome and it is expected that this level will vary considerably, depending on the particular contact materials and the type of application involved. It does seem important to utilize design techniques which will result in exposure of the contacts to a minimum amount of silicone vapors. A wide range of stability in silicone materials was exhibited in figure 1. The advantage of providing a reasonably long precure was also indicated. Provision of clean air ventilation around the contacts obviously would be beneficial. The selection of special contact materials and the application of special mechanical features, such as wiping action on make and break, should minimize the build-up of insulating deposits.

Summary

The chief purpose of this article is to point out that volatile silicone materials in the atmosphere surrounding electric contacts may result in poor performance or even failure. Where it is desirable to utilize the valuable high temperature properties of the silicone materials in the design of contact devices, special precautions may be required to assure satisfactory operation.

References

1. Effects of Commutator Surface Film Conditions on Commutation, C. Lynn and H. M. Elsey, AIEE Transactions, Vol. 68, Part I, 1949, pp. 106-12.
2. Effects of Silicone Vapor on Brush Wear, J. Marsden and R. H. Savage, AIEE Transactions, Vol. 67, 1948, pp. 1186-90.
3. Atmospheric Effects on Sliding Contacts, L. E. Moberly, Proceedings for Engineering Seminar on Electrical Contacts, Pennsylvania State University, 1956.
4. Private Communication, Dr. D. W. Lewis, Westinghouse Research Laboratories, Churchill Borough, Pittsburgh 35, Pa.
5. Effects of Pressure on the Thermal and Oxidative Degradation of a Methyl-Phenyl Silicone, L. C. Scala, W. M. Hickam, and M. H. Loeffler, Presented at the 135th ACS Meeting, Boston, Mass., April 1959.
6. Lectures presented by W. E. Campbell at the Engineering Seminar on Electrical Contacts, Pennsylvania State University, June 1956.

Spaulding FIBRE FACTS FOR ENGINEERS NUMBER 3

How to Use Vulcanized Fibre for Electrical Insulation

by Earl A. Russell, Chief Engineer, Spaulding Fibre Company, Inc.

While all standard grades of Vulcanized Fibre can be used for many electrical insulating applications, the more exacting uses call for Spaulding's Electrical Insulation Grade — Armite.

Spaulding Armite is produced in thicknesses of 1/32 inch and under with a consistently higher dielectric strength than is available in other grades of fibre.

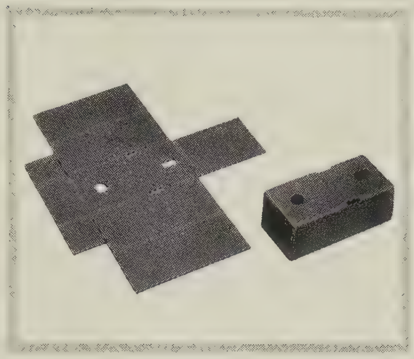
Special technical control of the manufacture of Armite makes it possible to combine this higher electrical quality with exceptional durability and forming qualities. Thus, Armite is particularly well suited for a wide range of both electrical and mechanical applications.

These uses include formed armature bonnets to insulate the windings from lead wires to the commutator, as well as for slot cell insulation in small armatures. Industry has also found extensive use for Armite in small, fractional horsepower motors. Here it is used in formed top sticks or wedges to insulate and anchor wires securely in the slots.

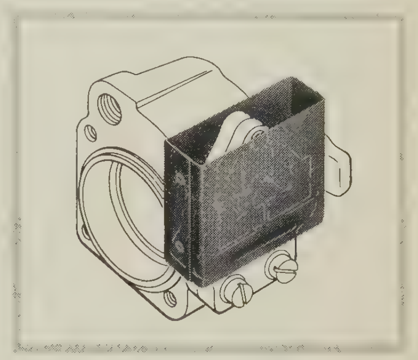
In "Barrier Insulation," the term used by Underwriters Laboratories for electrical insulation between live metal parts and adjacent live or ground metal parts, Armite finds one of its broadest applications. In this use, Armite insulators line the metal housing of electrical devices where space by itself is insufficient to provide gap insulation.

These Armite liners or "barriers" can be designed to accommodate almost any straight line contour. In .015″ or .020″ gauge Armite, fold lines are established economically by creasing in a punch press operation.

In thicker Armite, such as the more commonly used 1/32″, score lines are punched in a fast punch press operation. This permits folding to fit neatly inside the housing box. Whether creased or scored, Spaulding ships these parts flat and ready to be formed easily by hand for insertion.


For barrier insulation as switch box liner, Armite is creased in punching operation for rapid hand forming.

In these, as in a vast range of other applications, Spaulding Armite makes it possible to design and execute finished assemblies of assured electrical qualities without sacrificing economy.


For barrier insulation as removable terminal cover scored and formed, Armite is held in shape with eyelets and in place with indent at base.

Armite's superior dielectric properties, coupled with good forming and structural stiffness, have made it the traditional choice of designers throughout the electrical industry.

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Control of Quality of Nonrigid Polytetrafluoroethylene Tubing

By H. K. Graves, Supv. Electrical Engineer, Material Laboratory, New York Naval Shipyard, and L. E. Sieffert, Supv. Materials Engineer, Bureau of Ships, Washington, D. C.

Note: The opinions or assertions contained in this paper are the private ones of the authors and are not to be construed as official or reflecting the views of the Naval Service at large.

The Bureau of Ships recently issued Specification MIL-I-22129 (SHIPS) dated 21 August 1959 covering nonrigid polytetrafluoroethylene electrical insulating tubing. This type of tubing is intended for use at high temperature, high frequencies, or both. It has also been widely used in missile applications for its resistance to solvents such as hydraulic fluids used in various controls.

This article presents a portion of the data obtained by the Material Laboratory, New York Naval Shipyard, on which the specification limits were based. This information is discussed with three purposes in mind: (1) To point out the differences in properties obtained in tubing furnished by various suppliers, (2) to indicate relationships in properties which may furnish clues to manufacturers as to the reason for deficiencies in properties obtained, and (3) to demonstrate some of the reasons for the limits specified.

Material Laboratory data are available on three sizes of tubing—No. 12, No. 18, and No. 24 AWG.—from each of seven manufacturers, coded A to G, respectively. For the sake of brevity the data presented (shown in table 1) are limited to those obtained on size No. 24 AWG. The conclusions drawn are supported and not altered by the data on sizes No. 12 and No. 18 AWG.

A study of the data in table 1 illustrates that great differences in properties were obtained in the tubings submitted by the different manufacturers. In some properties such as wall thickness, concentricity, and retention of dielectric breakdown after condition C-96/23/96, only one tubing was deficient. In other properties such as lengthwise shrinkage, cold brittleness, and stress at 200% elongation, a wider difference in properties was noted.

It will be noted that the conventional tensile strength and ultimate

Table 1, Data on Size No. 24 AWG Non-Rigid Polytetrafluoroethylene Resin Tubing

Characteristic	Condition	A	B	C	D	E	F	G	Required
		Manufacturer							
Inside Diameter, inch	C-96/23-50	0.0241	0.0228	0.0234	0.0233	0.0201	0.0244	0.0226	0.020-0.027
Wall Thickness, inch	C-96/23/50	0.0110	0.0132	0.0125	0.0136	0.0097*	0.0104	0.0138	0.010-0.014
Concentricity, %	C-96/23/50	87.0	81.9	62.4*	76.9	74.0	77.6	83.0	70 (min.)
Dielectric Breakdown, volts	C-96/23/0	21,600	21,400	21,900	22,600	18,800	19,000	21,700	16,000 (min.)
Dielectric Breakdown, % of dry value	C-96/23/96	90.8	102	93.1	101	95.2	86.3*	109	90 (min.)
Lengthwise Shrinkage (a), %	E-2/300	1.9*	−.9	−1.4	−.53	2.53*	1.0	−1.2	1 (max.)
Cold Brittleness, °C	C-96/23/50	−52*	<−92	<−92	<−100	−60*	<−100	<−100	−65 (max.)
Fungus Resistance, rating	C-96/23/50	—	1	1	0	0	1	0	1 (max.)
Stress									
at 150% Elongation, psi.		7,130(4)	3,240	3,120	2,600	6,020	5,380(4)	2,820	—
at 200% Elongation(b), psi.		7,660(2)*	3,240	3,580(4)*	2,620	6,600(1)*	5,970(1)*	2,840	2,500-6,000
at 250% Elongation, psi.		8,240	3,280	4,280	2,680	7,310	6,840	2,900	—

NOTES:
(a) Minus signs denote elongation instead of shinkage
(b) None of five specimens shall break at or below 200% elongation
(4) Average of 4, 1 broke
(2) Average of 2, 3 broke
(1) 4 of 5 broke

** Indicates failure to conform to specification requirements.*

C-96/23/0 = 96 hours at 23°C and 0% relative humidity.
C-96/23/50 = 96 hours at 23°C and 50% relative humidity.
C-96/23/96 = 96 hours at 23°C and 96% relative humidity.
E-2/300 = 2 hours at 300°C.

elongation tests and requirements have been omitted with stress to attain 200% elongation substituted. This is the result of very extensive work with literally dozens of types of jaws and holding methods. Suggestions by other groups such as ASTM and SPI now working on methods and specifications for this tubing have been carefully investigated and it has been concluded that the difficulty of jaw or near jaw breaks is due to the nature of the material. At the start of pulling, the tubing elongates between the jaws and in so doing the elongated portion orients and becomes stronger than the tubing just inside or around the jaw. This very short section of the tubing is then pulled out of the jaw and forced to elongate very rapidly due to its short length. Probably not having sufficient time to orient, it breaks, and due to jaw and operator differences, results are so variable as to require very low and meaningless limits for a specification.

The inside diameter and wall thickness requirements are standard in industry for "normal wall" tubing. The results indicate little difficulty in meeting these limits (only one minor deficiency in seven sets of readings).

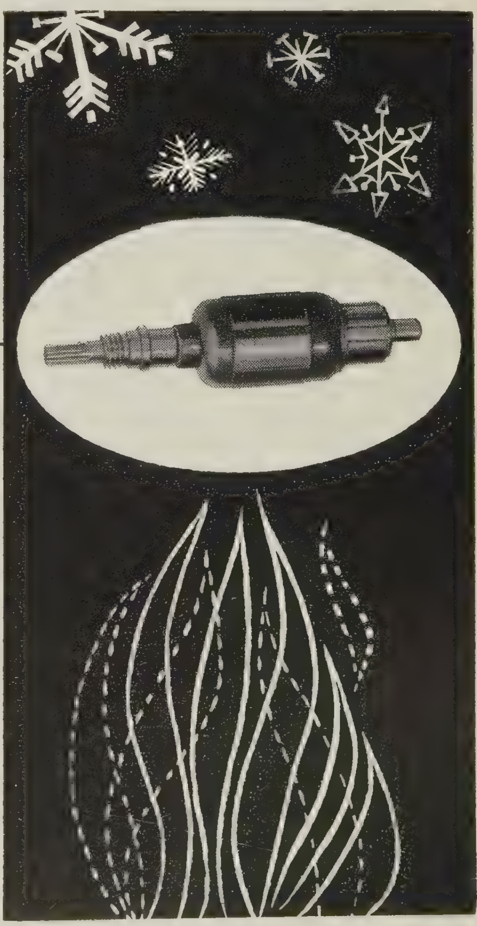
Only manufacturer C had difficulty with concentricity requirements, indicating that with proper control of manufacturing processes the specification can be met. Concentricity was also a problem in the early days of extruded vinyl tubing and rapid improvement would likewise be anticipated in this product as techniques are further developed.

None of the products failed to conform to the dielectric breakdown requirements after condtion C-96/23/0. The only failure in this property after condition C-96/23/96 was in the case of tubing supplied by manufacturer F. Based on the known resistance of polytetrafluoroethylene to high humidity conditioning, 100% retention would be expected. The 90% specified is designed to safely cover variations in the method. It should be noted that dielectric breakdown tests are made under oil and thus will not compare directly with those made in air.

None of the products failed to conform to the fungus resistance requirements as might be expected from the nature of the material, but contamination is an ever present possibility.

In the case of manufacturers A and E, the high lengthwise shrinkage and poor cold brittleness appear to be related to excessive stiffness as shown in the failure of many specimens to attain 200% elongation and the high stress in those specimens which did elongate 200%. In the case of manufacturer F, it would appear that a slightly lower degree of stiffness may also improve the borderline lengthwise shrinkage.

In summary, the results indicate that the specification limits for lengthwise shrinkage, cold brittleness, and stress at 200% elongation are somewhat related and that proper control of manufacturing processes will result in tubing conforming to the specification's limits.



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Pixilated Patents

By Mike Rivise

(Fortieth in a series of odd and interesting inventions in the electri-onics field from the files of the U.S. Patent Office.)

Trolley car drivers who would like to retire to a farm but who hate to get off the track would feel right at home driving a tractor on farms equipped with a device patented by Charles S. Doney of Flathead County, Montana, back on January 17, 1911. It consisted of means for powering a farm tractor with electricity supplied by overhead wire conductors.

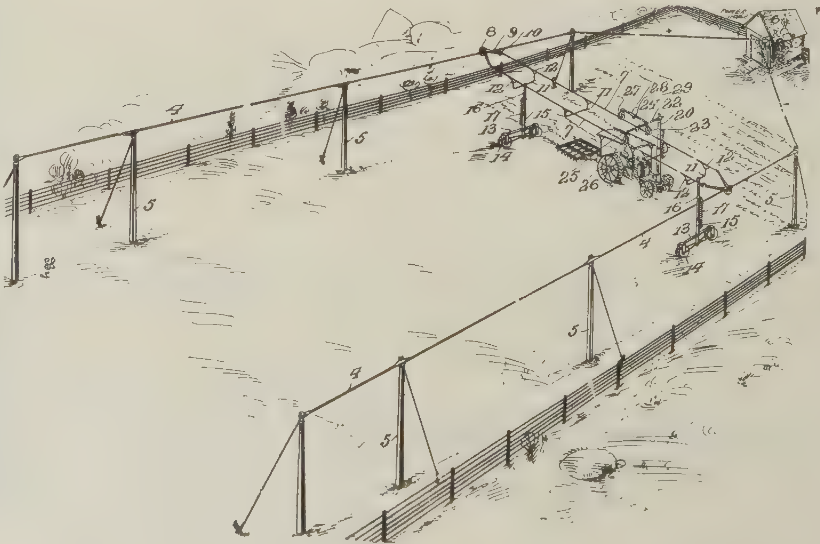
The patent description covers the supporting of an electrical conductor 4 on each side of a field or area to be covered by an electrical motor adapted to propel agricultural implements, the connecting of these conductors 4 by a pair of transverse wires or conductors 7, one of which is in electrical contact with one of the conductors 4 and the other with the other conductor 4, and of providing the vehicle to be propelled with a trolley pole carrying trolley wheels adapted to contact with the transverse conductors 7.

A series of spacers 11 extend between the conductors 7 and are connected to the conductors by suitable insulators 12. To prevent sagging of the conductors 7, supports 13 are provided at intervals, extending down from certain of the spacers 11.

On the support 13, 15 is a tube extended upward and 16 is a rod connected at its upper end to the spacer 11 and having its lower end extending into the tube 15. A compression spring 17, connected at one end to the rod and at the other end to the tube, is designed to hold the transverse conductors in their elevated position and at the same time permit the wheels of the supports to pass over inequalities in the ground.

A trolley pole having wheels adapted to run upon the transverse conductors and supply current to a motor is mounted upon the designated traction engine or other vehicle operated by an electric motor. The trolley consists of a tubular support 19 extending up from the engine with a slidable pole 20 mounted in it and connected by a tension spring 21. At the upper end, the pole is provided with an arm 22 which extends out at right angles from the pole, and 23 is a trolley wheel carried by the arm 22. Connected to the arm 22 by means of a pivot 24 is an arm 25, carrying at its end a second trolley wheel 26, the trolley wheel 23 being adapted to run on one of the transverse conductors and trolley wheel 26 on the other. The pivot 24 is to permit the trolley wheel 26 to always remain in contact with its transverse conductor 7. A third trolley wheel 27, carried by an arm 28, is provided to run on the same conductor as the trolley wheel 23. By using three trolley wheels engaging the two conductors, the wheels are caused to run at a fixed angle to the transverse conductor 7 and the trolley thus prevented from jumping or slipping off said conductors.

The editors were somewhat hesitant about bringing this detailed patent to the attention of *Insulation* readers for fear that it might be seized upon as a logical competitive product of a fuel cell-powered tractor now being developed. However, as usual, high journalistic ethics have prevailed and the patent has been presented in the belief that the better product will win.



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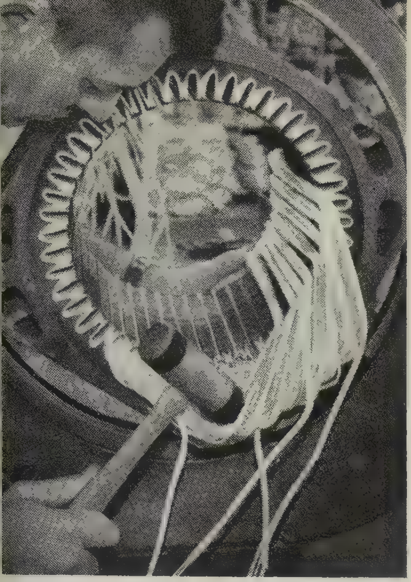

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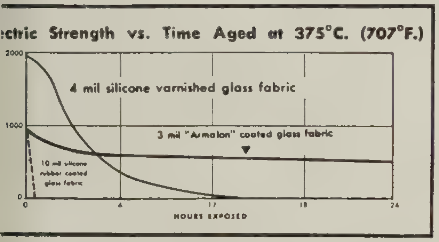

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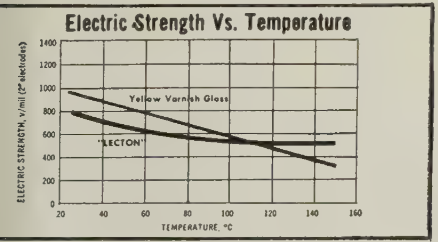

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SPECIFIC PROPERTIES* of single ply	3 mils	6 mils
Dielectric strength (¼" electrode)	> 750	> 500
Surface arc resistance, sec.	> 180	> 180
Dielectric constant		
60 cycles	1.8	2.3
1,000,000 cycles	1.7	1.8
Volume resistivity, ohm-cm		
room conditions	10^{19}	10^{19}
300°C	10^{13}	10^{13}
Insulation resistance, ohms (96 hrs. @ 90% R.H., 25°C)	10^{8}	10^{8}
Breaking strength, lbs./in. of width, warp	> 40	> 50

Note: Standard single-ply constructions – available in 4, 5, 8, 10 mils, also – come in rolls or sheets ¼" to 38" wide; laminates in rolls or 13" x 17" sheets – 6 to 25 mils thick.

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SPECIFIC PROPERTIES* of single ply	3 mils	7 mils	14 mils
Dielectric strength (¼" electrode)			
@ 25°C	> 1000	> 800	> 600
@ 130°C	> 700	> 600	> 500
@ 25°C after 4 days at 90% R.H.	> 900	> 700	> 550
Surface arc resistance, sec.	> 180	> 180	> 180
Volume resistivity, ohm-cm			
@ 25°C	10^{14}	10^{14}	10^{14}
@ 130°C	10^{12}	10^{12}	10^{12}
@ 25°C after 4 days at 90% R.H.	10^{14}	10^{14}	10^{14}
Breaking strength, lbs./in., average, W X F			
straight	90x150	140x120	250x250
bias-cut		55	
Elongation at rupture, %			
straight	3	3	3
bias-cut		35	

Note: Standard single-ply constructions – available in 5, 10 mils, also – come in rolls or sheets ¼" to 60" wide; 7 and 10 mils offered both straight and bias-cut. Laminates supplied in rolls 20 and 30 mils thick, and in 18" x 18" sheets .060", .072", or 3/32" thick.

*Derived from standard testing methods. These data are a guide to properties and are not to be regarded as specifications.

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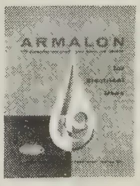

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Sprayable Epoxy Bonds Motor Stacks

Epoxy adhesive bonded stacks can be made far more accurately, more uniformly, and more swiftly than riveted motor stack assemblies according to Peter K. Studner, Chief Engineer of Stator Electric Corp., Long Island City, N. Y. In addition, he reports that they can be produced without the internal stresses that have plagued the industry for years.

Stator Electric Corp. is a manufacturer of complete stators and rotors used for military and commercial applications. They are used in missiles, computers, aircraft, Navy equipment, recording equipment, etc.

In the manufacture of high strength bonded stacks to precision tolerances, the company follows a modified assembly line technique which enables them to process over 60 different varieties at any given time.

The steel laminates used are stamped by outside vendors. Upon arrival, they are cleaned both with conventional solvents and by newly refined ultrasonic techniques. The next step is sorting, after which they are set out on large wooden panels for mass spray application of the adhesive. The formulation used is a two-part, thermosetting, formulated solvent-dispersed epoxy adhesive, "Bondmaster" E645 (manufactured by Rubber & Asbestos Corp., Bloomfield, N. J). The freshly mixed material has a viscosity of approximately 1,000 cps at approximately 60% solids. To this adhesive formulation, Stator Electric Corp. adds further solvents to yield maximum sprayability, and specially developed fillers which incorporate added high strength factors. To assure optimum properties for highly critical applications, no more than a few quarts are prepared at a time and the mixture is kept under constant refrigeration.

In the next step in production, the stamped laminates are sprayed on one side only in a conventional spray booth. Less than a 1-mil coating is applied (figure 1).

After spraying, the adhesive dries to a tack-free surface at room temperature and coated parts may be stored, if desired, for periods of up to six months at room temperature without adverse effect. However, since the adhesive film must be kept clean and dry, Stator Electric air-dries in dustproof cabinets to insure optimum uniformity. The adhesive-coated laminates are then promptly stacked by hand on custom-constructed arbors (figure 2). These are then placed in a specially designed jig under spring pressure (figure 3).

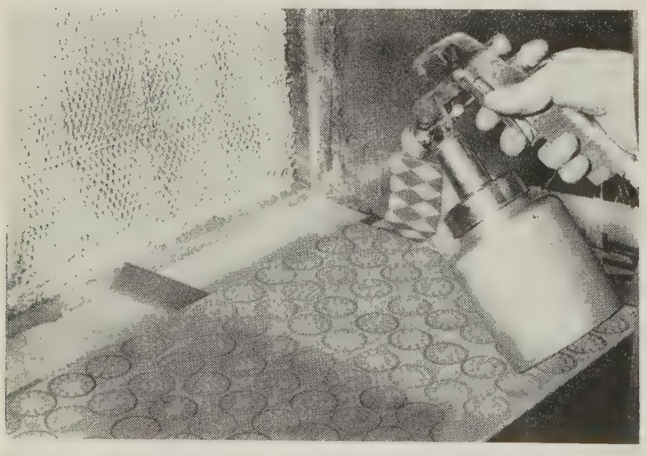

Figure 1, laminates are spread out on a wooden panel and sprayed with adhesive.

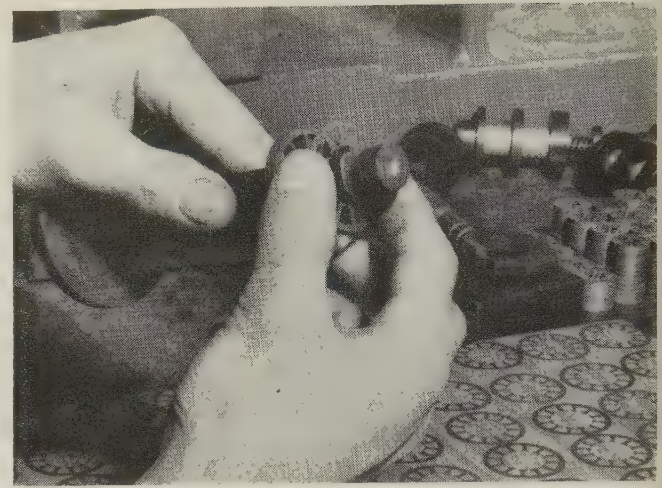

Figure 2, after spraying, laminates are stacked by slipping predetermined number over an arbor as shown.

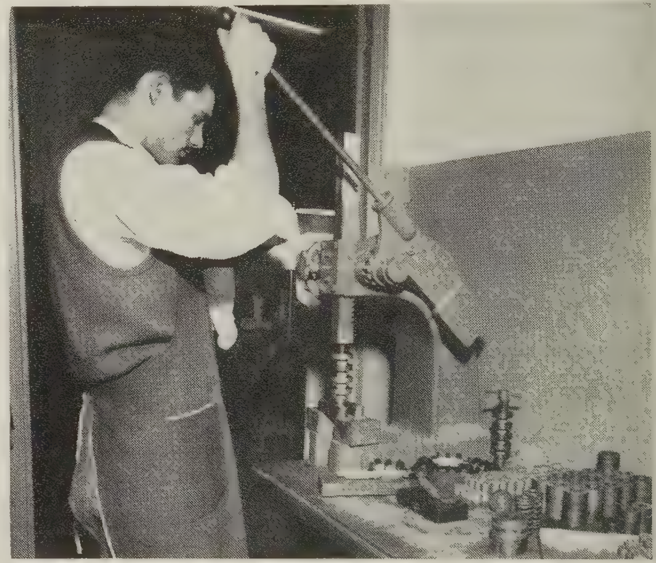

Figure 3, the arbor is placed in a hand press and pressure springs are inserted to keep constant pressure on laminate stacks.

This stacking assembly is then placed into a programmed heat oven where the stack is subjected to elevated temperatures in a carefully controlled heat-cure cycle (figure 4). Normal cure temperatures at the glue line range from 265° to 400°F, although extended curing at temperatures below 375°F is most commonly employed since it is practically impossible to degrade the adhesive in that range even if the recommended cure time is exceeded.

Before curing, the epoxy adhesive is thermoplastic and flows freely as the temperature is raised. This allows the films to fuse to a stronger bond, and assures the complete "wetting" of the materials being bonded. For certain specialized applications, however, it is necessary to retard the normal flow-out. This can be accomplished by partially curing the adhesive, at contact pressure only, for about one-quarter to one-half its "minimum gel time" and then using normal time and temperature cycles but with slightly increased pressure.

In all instances, high pressure is not needed to effect the bond, but it is essential that the coated surfaces be in complete and intimate contact over the entire area of the materials being bonded. Accordingly, sufficient pressure to accomplish this is provided by the special spring pressure fixtures. The specific amount of pressure needed will vary depending upon the flatness of the components, porosity, resiliency, etc.

After curing, the adhesive-bonded stacks can be subjected to honing, machining, grinding, etc., without fear of damage to the completed assembly (figures 5 and 6).

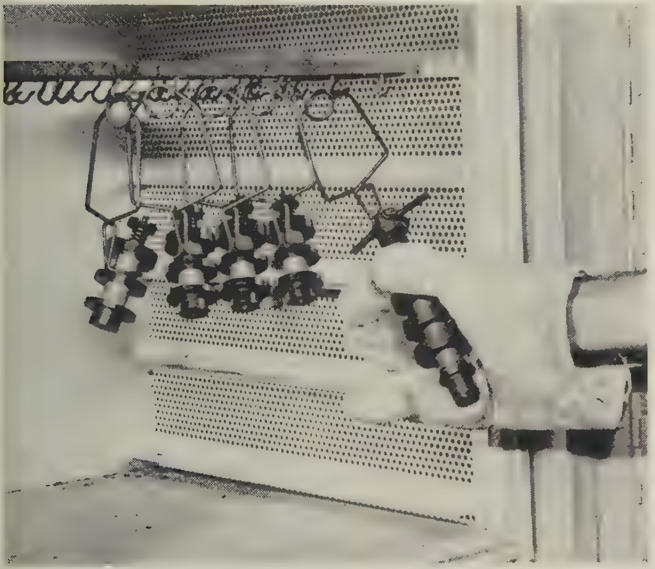

Figure 4, the spring-clamped stacks are then placed into the oven for heat-curing.

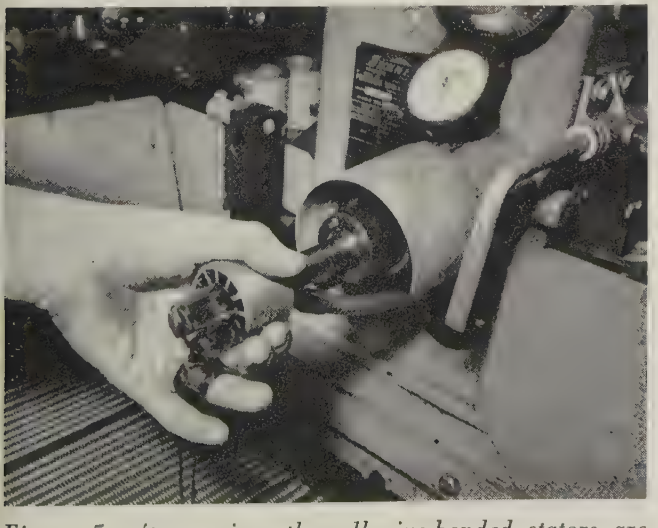

Figure 5, after curing, the adhesive-bonded stators are honed as shown.

This aspect is carefully checked by both mechanical and electrical inspection at this stage. There has never been a rejection due to failure of the adhesive in the history of Stator Electric's operation.

After this step, the bonded, machined stators are inserted, wired, finished, (figures 7 and 8) and again tested. Either potting or impregnation follows.

All photos courtesy Rubber and Asbestos Corp., Bloomfield, N.J.

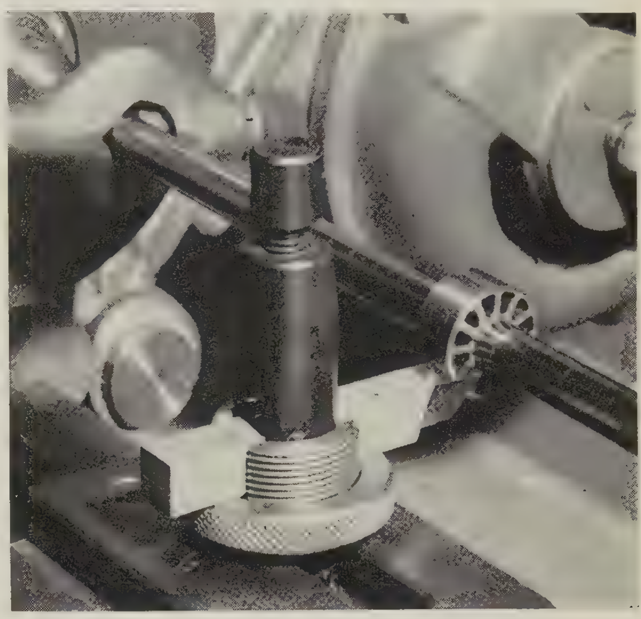

Figure 6. the bonded stator is machined. if necessary.

Figure 7, stators are then wired to complete the assembly.

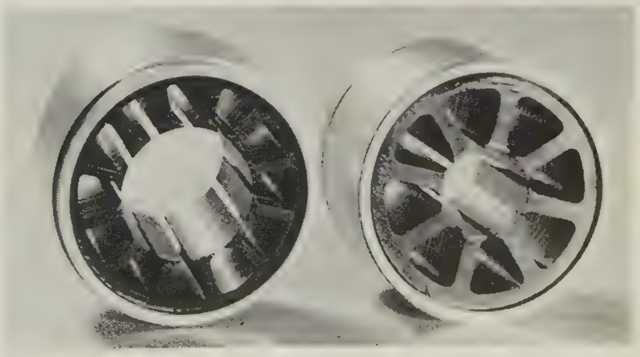

Figure 8, view of two stators (not wired), honed and machined to precise tolerances, which have been inserted into shell.

Gains Cited, Insulation Topics Discussed, At SPI Reinforced Plastics Meeting

Some 80 technical papers, many of them dealing with electrical insulation subjects, and a display of 350 products, attracted an attendance of more than 1,000 at the February Annual Reinforced Plastics Division Conference of The Society of the Plastics Industry, Inc., in Chicago.

A. W. Levenhagen, general chairman of the division, reported at the meeting that sales of reinforced plastics rose 42.5% in 1959 over 1958 and were kept from going higher only by the shortage of fibrous glass used as a reinforcing material in most products. Estimates for 1960 sales of reinforced plastics range from 10 to 20% over the 264-million pounds sold in 1959. For 1965, sales are being projected at an annual rate of 525-million pounds.

Reports on several papers presented at the meeting which are of interest to electrical insulation users follow.

Preparation and Properties of Reinforced Laminates Made at Contact Pressure From 100% Silicone Solventless Resin.

By D. T. Retford, M. E. Nelson, and K. R. Hoffman, Product Engineering Laboratories, Dow Corning Corp., Midland, Mich.

Reinforced flat silicone laminates are used to make slot wedges, spacers, mounting boards, insulation washers, coil forms, and such related parts. Molded reinforced silicone laminates are used in many applications, such as transformer barrier tubes, coil forms, and radomes.

In the past it has been necessary for fabricators to obtain silicone-preimpregnated, B-stage reinforcement when desiring to produce silicone laminates. Curing has normally been done in a hot press.

To overcome these limitations, a new system of silicone resins has been developed. These resins, Dow Corning R-7145 and R-7146, are low viscosity, solvent free liquids. Chemically, the resins are vinyl containing, linear polysiloxanes that cure through an addition reaction.

All previous silicone laminating resins have cured through a condensation reaction that formed water vapor. This water vapor caused excessive void spaces in the finished laminate if external pressure was not applied during the cure. However, no volatile gases are produced when an addition reaction takes place. Hence, external pressure is not necessary to prevent void formation during the cure of a solventless silicone laminate.

From a practical point of view, the new silicone resins allow a fabricator to use wet layup techniques and oven cures to make thick, void-free laminates. This means that any fabricator can take dry reinforcement "off the shelf," wet it with one of these new solventless silicone resins—also "off the shelf"—and make a reinforced silicone laminate. The resulting laminate will have the excellent electrical properties and thermal stability typical of silicone laminates.

The handling procedures for making a reinforced solventless silicone laminate are similar to the procedures used with polyesters. However, there are differences.

The laminates were cut into halves and heat aged 200 hours at 482°F. Both halves were then tested either for electrical or physical properties. The strength properties were slightly lower than those for a similar laminate prepared from silicone-resin-preimpregnated, B-stage, glass cloth and cured in a hot press. The lower strength values for the experimental laminates were probably due to a resin content higher than the resin content in press cured laminates. The electrical properties were typical for silicone laminates. Little change in either dry or wet electrical properties was evident even after 200 hours aging at 482°F.

Many applications for reinforced silicone plastics require a complex shape, i.e., not flat. The form on which the layup is to be made must be cleaned and coated with a silicone release agent. A dry layup is made on the form and then saturated with the resin. The resin may be applied by brushing or some other suitable manner which avoids entrapping air bubbles. The surface of the wet layup must be covered during the cure. Covering is necessary to prevent inhibition of the cure of the resin at the surface.

The movement of resin within the laminate must be controlled during the cure. There is a rapid decrease in viscosity of the resin as it is heated in the curing oven. When the cure temperature is reached, gelation commences and the apparent viscosity of the resin rapidly rises. However, the initial viscosity decrease requires that special techniques be used in fabricating a part containing vertical sections. If precautions are not taken, the resin will run out leaving "dry" spots in the finished laminate. To restrict resin movement in a laminate of uniform cross section (such as a tube), the laminate may be tightly wrapped with the surface covering material. Resin flow in more complex shapes of uneven cross sections can be controlled by curing in a vacuum bag. An alternate method of controlling resin flow is to add a thixotropy-producing filler to the resin before making the layup. Extreme situations may require some combination of these methods.

The techniques of vacuum bag laminating are readily adaptable to use with the solventless silicone resins. This type of laminating not only insures good compaction on curves and angles, but insures restriction of resin flow during cure. The procedure for vacuum bag laminating is quite similar to the method used in contact pressure laminating.

A special cure technique may be used in unusual situations such as when the layup is bulky or made on a heat sensitive form. These conditions usually prevent oven curing of the laid-up form. The resin in such layups has been hardened by using infrared lamps. The heating with the lamps was uniform and not too intense. After heating sufficiently to harden the

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resin, the layup was removed from the form and given the normal oven cure, starting at 300°F, to develop maximum properties.

Other techniques commonly used in wet layup fabrication have been used successfully with these resins. Tubes have been made by wrapping dry asbestos paper or glass mat on a mandrel and vacuum impregnating with resin. These tubes have shown potential as transformer barrier tubes. One such tube was heat aged 1000 hours at 575°F without losing its physical strength and still possessing an electric strength in excess of 160 volts per mil. Other tubes were prepared by passing continuous roving through a dip tank containing resin and then winding on a mandrel. Molding with matched metal dies using glass roving and filled resin has also been successful.

New Copper-Clad Glass Reinforced Laminates for Electrical Use

By F. H. Bratton and F. U. Zolg, Chemistry and Abrasives Research Dept., The Cincinnati Milling Machine Co., Cincinnati 9, Ohio.

Current market usage is being met predominantly by paper base copper-clad phenolic laminates and glass cloth reinforced copper-clad epoxy laminates. The copper-clad paper base laminate is used in over 75% of the total printed circuit applications. Its major attributes are low cost, good electrical and mechanical properties, and ready availability from numerous established producers.

However, fabricators of printed circuit boards in large volume would welcome higher impact strength and lower thermal coefficient of expansion to minimize breakage and warping in automated fabrication of circuits, greater arc resistance, dielectric properties which are more stable over a broad temperature range, and greater resistance to mechanical degradation due to thermal aging.

The copper-clad glass cloth reinforced epoxy laminate is characterized by high mechanical strength, above average thermal resistance, and good electrical properties. Its major disadvantage is its high cost, which is approximately three times that of the copper-clad paper base phenolic.

A copper-clad laminate which meets present and future product requirements would be characterized by high impact strength, good thermal resistance, low water absorption, low coefficient of expansion, high electrical insulation properties, good cold punching quality, competitive cost, and postformability.

An analysis was made of the properties of various types of reinforced plastics. An examination shows that replacement of the paper base reinforcing material with glass, even of the non-woven type, upgraded the mechanical properties to the point where major differences in structural strength can be anticipated. Further, the thermal coefficient of expansion of the glass reinforced laminate is about 50% of that of the paper base laminate and more closely approximates that of copper. As a consequence, the distortion of copper-clad glass reinforced systems is reduced on thermal cycling. These considerations led to the conclusion that a glass reinforcing material is well suited for the preparation of the higher quality copper-clad laminate. A non-woven glass fiber reinforcement was ultimately selected on the basis of the relative costs.

The second phase of preliminary research invesigations was concerned with the examination of polymer systems for bonding the non-woven glass reinforcement to provide the necessary copper-clad glass reinforced laminate. The ester-type polymer systems provide many attractive properties such as low cost and low pressure processing, high arc resistance, low dielectric constant, low dielectric loss, high insulation resistance, and low water absorption. Even so, the very low order of adhesion to copper militated against their use without modification.

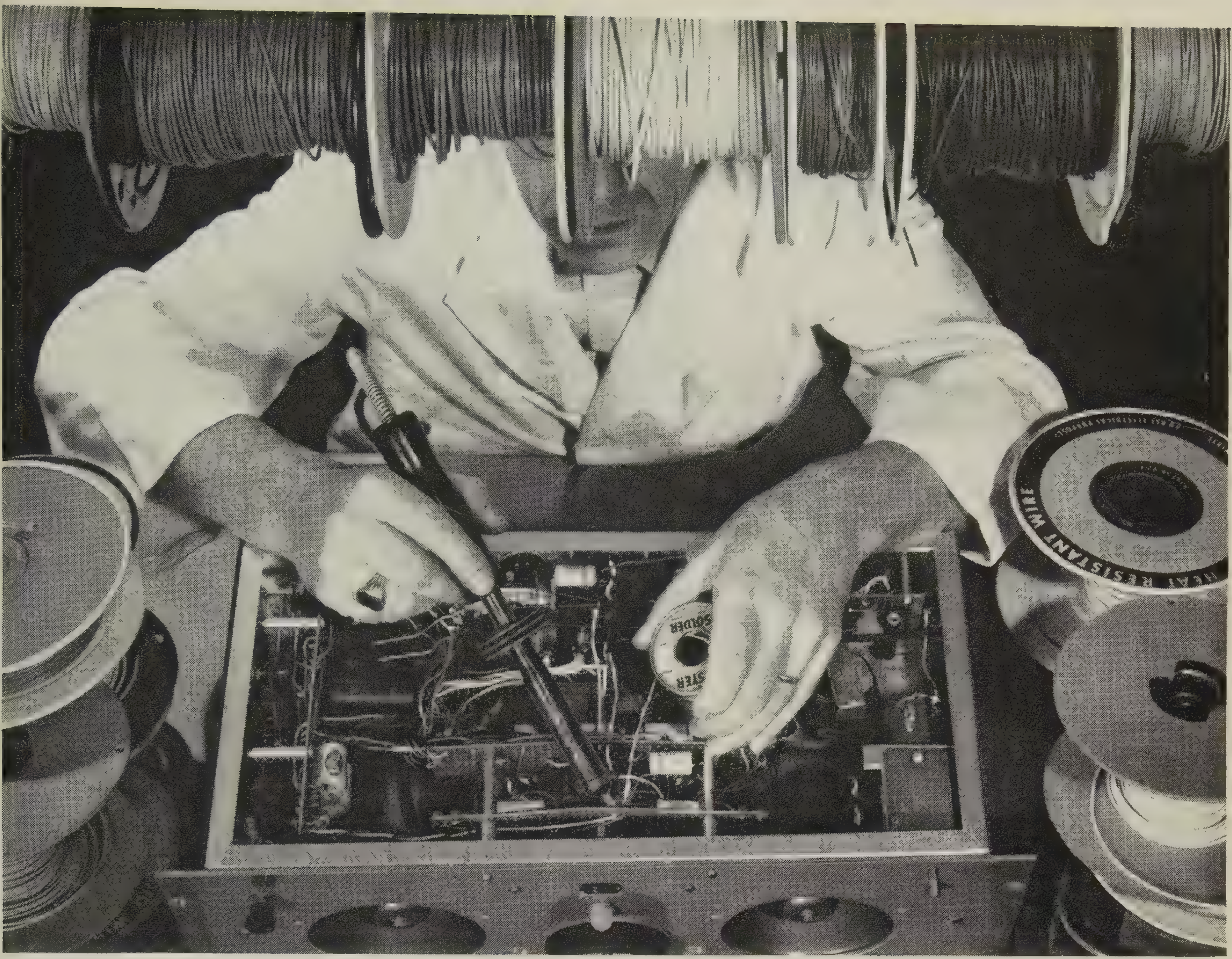
It was established that an ester-type polymer system could be suitably modified so that it could be molded in the presence of glass reinforcement and copper foil to provide peel strengths as high as 12 pounds per inch of copper.

The typical properties of the new CMMCo glass reinforced laminate indicate that it provides a high quality electrical insulation system with excellent physical and mechanical properties. The high notched impact strength of 18 ft lbs/in permits rough handling of the printed circuit without danger of breakage. The low water absorption of 0.08% is of interest. The dielectric loss properties are particularly attractive. Arc resistance of 40 seconds is sufficiently high for general electronic usage.

The product exhibits good retention of properties at elevated temperatures. The heat distortion point of this new copper-clad material is 230°C. There is an increase in peel strength of 75% when measured at 90°C as compared to that measured at room temperature. A reduction of 30% is observed when this measurement is carried out at 130°C. This new copper-clad laminate can be exposed for 60 seconds to a solder bath at 232°C, for 10 seconds to a bath at 260°C, and for 3-5 seconds to a bath at 316°C without blistering. After cooling to room temperature, measurements show over 90% of the initial peel strength is retained.

One accelerated test procedure used to measure the deterioration of copper-clad laminates upon prolonged exposure to heat is to subject printed circuits made from copper-clad laminates to a temperature of 128°C for eight weeks. Upon completion of this test both mechanical properties and peel strength are determined. After being subjected to this accelerated aging test, both flexural strength and modulus are unchanged. The absence of brittleness in the aged material is of great importance, particularly with respect to reduced field breakage in the repair of devices which have been in use several years.

As is usual with copper-clad laminates the peel strength of the new copper-clad material was reduced by this accelerated aging test. Research on the cause of this loss in peel strength showed that oxygen diffusion played a rather important part. Apparently a formation of copper oxide at the edges of the circuit caused a reduction in the effective area adhesively bonded to the laminate plus leading to the observed loss in peel strength. Interestingly enough, this



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loss in strength reached a limiting value beyond which little further loss occurred.

Chemical resistance of the new copper-clad laminate can in general be considered to be more than adequate. Some care, however, must be taken when certain chlorinated solvents are used.

Retention of electrical properties after treatment with etching chemicals is an essential characteristic of printed circuits. Electrical properties are maintained after etching. Retention of electrical properties under high humidity conditions and at ambient temperatures likewise is an essential characteristic of printed circuit materials. Insulating properties are substantially retained in the ASTM "Condition C" test involving exposure for 96 hours to 90% relative humidity at 95°F. Exposure of the laminate to these conditions imposes only a temporary effect as the circuit returns to its original insulation resistance value within a short time after removal from the high humidity chamber.

Ways were devised to achieve self-extinguishing properties in the new laminate and at the same time obtain high quality printed circuit boards.

Some care is required in the use of the laminate in production operations which involve the use of chlorinated or ketone solvents. Short time and low temperature exposure to these materials is recommended. It has been found best to punch the material at room temperature.

Technical Capabilities and Development In Electrical Engineered Missile Units

By Gim P. Fong, Manager of Technical Departments, and Ralph C. Pratt, Research Engineer, Research Div., Plastics Plant, Raytheon Co., Maynard, Mass.

Plastic materials used by the electronics industry are divided into two basic categories; those primarily concerned with electrical properties and those primarily concerned with structural properties. On occasion, it is necessary to design plastic components to meet both rigid electrical and structural specifications. Where this occurs, an optimum point in design is selected. Then the overall general project is re-evaluated as to feasibility, and the general specifications relaxed to the limitations of presently available plastics, methods of fabrication, environmental requirements, etc.

The electronics industry was initially concerned with the mechanical and dielectric strength properties of new plastics. Not too much thought was given to such properties as dielectric constant, electrical losses, and semiconductor properties or the extent to which these properties could be controlled and varied.

With the wide and ever growing application of reinforced plastics in the missile and aircraft field, it is sometimes forgotten that the original concept in developing glass reinforced plastics was specifically to meet electronic requirements in radomes. The radome has exerted more influence on the progressive development of this material than any other application.

Plastic radomes have been designed to protect the radar units. Of principal interest are the glass-cloth-epoxy and polyester resin laminated structures. The plastic radomes are used principally because of their superior mechanical properties, high interlaminate shear strength, good fatigue-weather resistance, and the fact that, basically, electrical transmission properties can be met and controlled.

A radome does not transmit all the RF energy incident upon it, but reflects and absorbs certain fractions of that energy. If sufficient reflected RF energy finds its way back down the feed line to the transmitter, frequency pulling or reduction in range can result from attenuation of the transmitted signal. This is especially true, since the attenuation in the outgoing signal is repeated on the return signal. Radar range is proportional to the fourth root of the transmitter power, so that range reduction is related to radome transmission power. The radome transmission formula is the range reduction percent equal to one-way transmission percent divided by two. As an example, if one-way attenuation due to radome wall reflection is 12% and due to absorption is 8%, then the range will be reduced by a 10% pattern. Reflection and absorption of the radome wall can reduce the absolute value of the radiation pattern by the process described above.

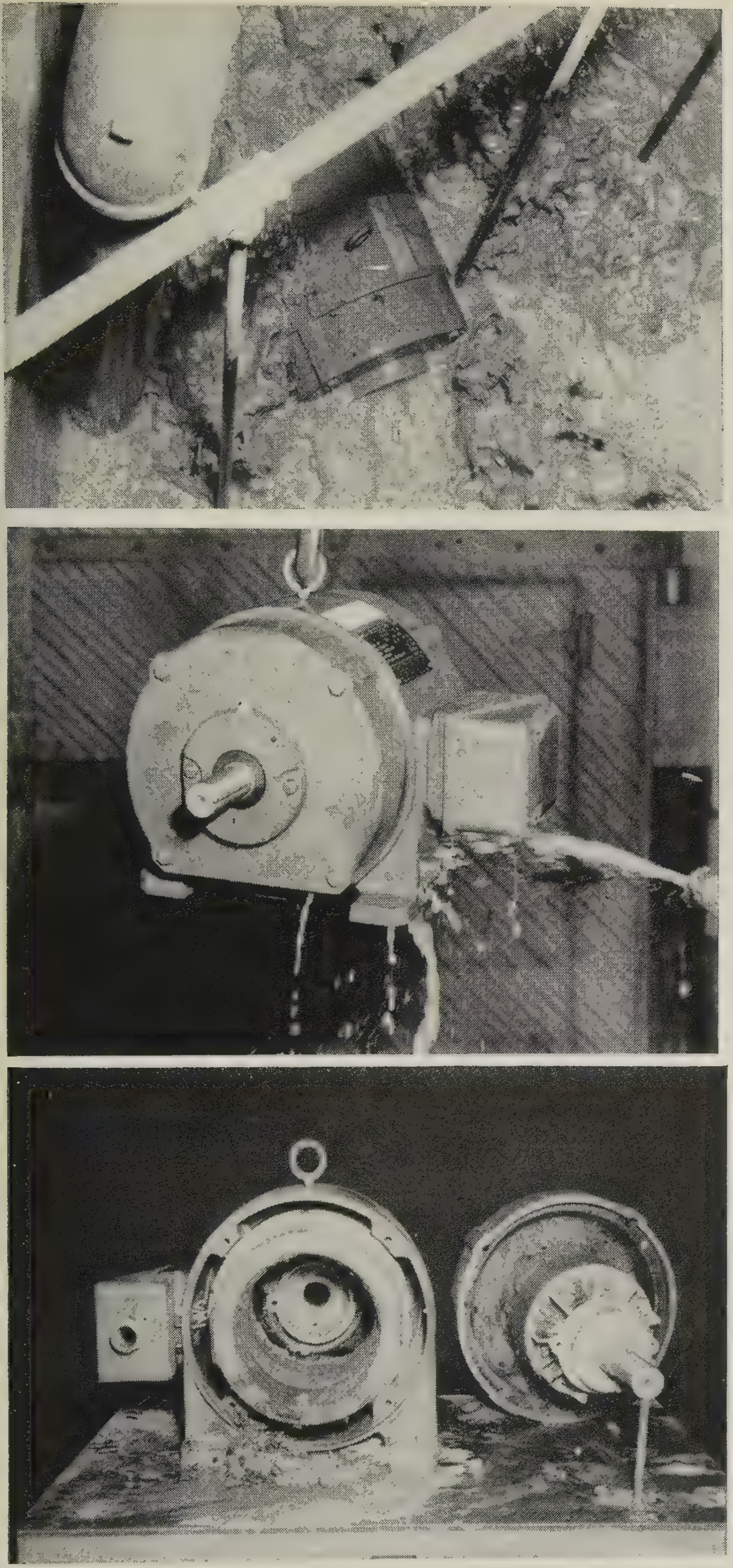
Pattern distortion is especially objectionable in cases of a pencil beam which is being used in the conical scan for precision direction finding and in the case of a shaped beam that is being used for uniform illumination of the ground. Pattern distortions have been traced to a variety of causes and in some cases, the effects were barely appreciable. In most cases, they were serious enough to require study and elimination.

The designer of radomes desires to produce a product which will completely transmit all incident electromagnetic wave (RF) with no reflection or absorption. This type of design is physically impossible so that the purpose is to develop radomes as close to "perfect" as possible. To meet the ideal radome requirement, basic knowledge of radome design is required, but in addition, material behavior and technique of fabricating ideal radomes knowledge is required.

Reflection of RF waves occurs only at a discontinuity; i.e., at the transmission of one medium to another. All radome walls can be considered as discontinuities. The spacing between walls is an important factor in reducing reflection, absorption, etc. The overall reflection problems will result from super position of the individual reflections caused by discontinuities. Reflections can be reduced or transmission increased by either reducing each of the individual reflections or by adjusting the spacing between the discontinuities to obtain partial or complete cancellation.

Electromagnetic waves are reflected at any sharp discontinuity in the electrical properties of the medium through which they travel. Hence, any object whose conductivity, permeability, or dielectric constant is substantially different from that of empty space will reflect signals from a radar transmitter. The reflected energy on a target behaves similar to a ball bounced off of a wall.

It is to be noted that the radar target need not be a good conductor, provided its dielectric constant is



The pictures above show the tests which Allis-Chalmers motors have passed. The first shows a motor as it was submerged in agitated muddy water for a full day. It was then hosed out, regreased, connected and rerun; (middle photo). Bottom photo shows a second motor taken apart to reveal the large quantity of mud that accumulated inside. Despite this, it was still in running condition.

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"Epoxylite" compound based on BAKELITE Brand epoxy resins, encapsulates the mud-bathed motor here. Success with epoxy compounds begins with success in epoxy resins. BAKELITE Brand epoxy resins are successful because the people of Union Carbide have learned so much about what they can do and how they should be used. To share in this wealth of experience, write Dept. DN-30L, 30 East 42nd Street, New York 17, N. Y. *In Canada,* Union Carbide Canada Limited, Toronto 7.

◀ *Electric motors made by Allis-Chalmers Corporation have coils embedded in "Epoxylite" compounds formulated by Epoxylite Corporation, El Monte, Calif., based on BAKELITE Brand epoxy resins.*

Insulating printed circuits is another of the important jobs performed by BAKELITE Brand epoxy resins. Strong, impact-resistant, and able to withstand high temperatures, epoxies provide a big boost in performance.

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substantially higher than that of the air through which the radar wave travels. In a practical sense, virtually any solid object, as well as many liquid and gaseous conditions, may be detected by radar.

There are many different type reflectors used. The parabolic reflectors are made of different materials, such as all reinforced plastics, all metallic units (incorporating adhesives) and composite plastics-metal units. In order to produce the ideal reflector, plastics engineers are required to work very closely with electronics systems engineers in determining the type of materials and method of fabrication to produce reflectors. One major requirement for reflectors is that close electrical tolerances must be met. In order to meet the electrical tolerances, it is vital that extremely close mechanical tolerances are met.

Polarized gratings operate on the principle similar to optical polarization through various mediums. The electrical type grating polarizes RF energy in accordance with the specific requirements. The requirements permit the transmission of desirable waves and the rejection of undesirable waves. The undesirable waves are absorbed or cancelled by different design techniques which generally require the use of specialty plastics materials. In the Sparrow Polarizing Grating, the composite structure meets severe electrical requirements by using dissimilar materials such as metallic parallel electrical conducting strips, resistive mineral filled-electrically conductive plastics spacers, rubber components, reinforced plastics mounting rings, and glass reinforced plastics skins. Each specific material is accurately prepared in regard to compounding and dimensional accuracy. The different type materials all have specific electrical and mechanical requirements to meet.

Previous requirements for ablative materials on missile nose cones, outer missile motor body, etc., generally only involve heat or mechanical requirements. Present missile developments are requiring more use of electrical transmitting mediums on external surfaces such as nose cone, missile body, fins, and tail cones.

These particular new requirements must still meet combinations of high temperature structural properties, high temperature insulation, ablation characteristics, ease of application, etc. By adding electrical requirements, problem areas definitely exist. Various type reinforced plastics, ceramoplastics, ceramics, and refractories are applicable.

In regard to external heat insulation, ablative coatings, heat erosion characteristics, etc., the Tri-ester Polymers are producing interesting and unusual results. These resin systems can produce different type properties. The basic polymer produces electrical requirements at X-Band of 3.0 to 4.5 dielectric constant and .001 to .003 loss tangent. These values can be changed to meet other electric values by incorporating different formulations.

The Tri-ester Polymers are useful as ablation and heat resistant coatings for the presently available reinforced plastics radomes. These polymers will prevent damage of radomes where extremely high temperatures (supersonic speeds) exist in certain missiles. The dielectric properties of the Tri-ester Polymer will change as the electrical thickness changes. The polymer does not carbonize and therefore, has no ill effect on electrical transmission.

Temperature Cycling of Laminates Applicable to High Temperature Aircraft Radomes

By B. G. Kimmel, J. S. Schiavo, and G. D. Robertson, Microwave Laboratory, Hughes Aircraft Co., Culver City, Calif.

A radome intended for use on high speed aircraft must fulfill several important requirements. Besides being structurally and electrically acceptable at the time of its manufacture, the radome should possess sufficient thermal stability to withstand a reasonably large number of high speed flights without undergoing serious changes in structural and electrical properties. The question arises whether a reinforced plastic radome based on any of the commercially available resins has sufficient thermal stability for the rigors of high speed flight. For conventional, conical-nose radome applications, in which a maximum temperature of no more than 550°F is anticipated, a glass-cloth-reinforced or filament wound structure would probably prove to be adequate. The relative suitability of the most promising resins with respect to retention of important structural and electrical properties was not known. Therefore laminates made of several types of heat-resistant resin were tested after continuous heating and after temperature cycling.

The resins considered most promising in the fabrication of high performance reinforced plastic radomes include the silicones, some of the more heat-resistant phenolics, and the recently developed phenyl silanes (silane-modified phenolics).

The silicones, which retain most of their important structural and electrical properties after prolonged exposure to elevated temperatures, possess relatively little strength compared with the phenolics and phenyl silanes. The loss tangent of the silicones is, however, attractively low and remains almost constant over a wide temperature range. In addition, the dielectric constant remains essentially unchanged with changing temperature. This latter property is important when alteration of temperature dependence of certain electrical properties is considered.

Both the phenolics and the phenyl silanes possess relatively high mechanical strength over a wide temperature range, and the phenyl silanes are reputed to retain this strength after prolonged high-temperature exposure. However, the dielectric properties of laminates based on these resins are not nearly so desirable as those of the silicone laminates. The loss tangent is somewhat higher and, in some cases, increases with increasing temperature. The dielectric constant of both phenolic and phenyl silane laminates increases markedly with temperature, and with the presently known dielectric fillers, significant adjustment of the temperature dependence cannot be expected.

An attempt was made to rank the various types of laminates according to the degree of retention of readily determined mechanical strength and electrical properties after repeated

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temperature cycling between room temperature and 550°F.

It is extremely important that the electrical properties as well as the mechanical strength of an aircraft radome be maintained within certain specified limits. Therefore, the effect of temperature cycling on the dielectric constant, electrical thickness, and in some cases loss tangent, was determined.

The phenyl silane laminates retained a higher percentage of flexural strength than any other type of laminate. Even the most heat-resistant phenolic degraded extensively after 100 temperature cycles. The room temperature flexural strength of the silicone laminates decreased markedly as a result of cycling; this was probably due to extensive cracking and crazing.

The phenyl silane laminates retained a higher percentage of tensile strength than any other type of laminate. The tensile strength of the silicone laminates decreased by a relatively large amount at both room temperature and 550°F.

The phenyl silane laminates are seen to be far superior to the other types of laminates in the compressive strength at 550°F (as well as the 550°F flexural and tensile strength). This apparently increases somewhat with temperature-cycling, which is undoubtedly an effect associated with further postcure during cycling.

Electrical properties, thickness, and weight loss are discussed together, principally because they are so closely related to one another. For example, both the change in physical thickness and the change in dielectric constant contribute to the total variation observed in the electrical thickness. Also, a weight loss implies either shrinkage (decrease in physical thickness) or substitution of air for the more unstable portion of the plastic phase of a laminate, or both.

The weight loss and change in electrical properties, including the dielectric constant, electrical thickness. and loss tangent, of the silicones and phenyl silanes are both relatively small after prolonged temperature cycling. In the phenolics, however, these properties change to an intolerably large degree. The relative amounts of change in the electrical properties correspond fairly closely to the degree of retention of physical properties of the laminates except in the case of the silicone laminates where the decrease in physical strength seems to be associated more with crazing of the resin than with weight loss. It is also observed that the physical thickness of silicone laminates increases substantially with prolonged cycling. This is possibly due to stress relief associated with the extensive cracking and crazing of silicone laminates during temperature cycling.

The effect of essentially continuous exposure to 550°F on the weight and microwave electrical thickness of laminates made from phenyl silane and phenolic resins was determined from measurements made at intervals on laminates stored in a 550°F oven. The results after approximately 100 hours exposure indicate that phenyl silane laminates withstand continuous exposure at 550°F equally as well as an equivalent period at that temperature in a series of temperature cycles. A phenolic laminate was found to withstand continuous exposure at 550°F only slightly better than the equivalent period of temperature cycling.

From the experimental results, several conclusions can be drawn regarding the suitability of the resins under consideration for use in fabricating high performance aircraft radomes: 1) The phenolics, even the most heat resistant now commercially available, are unsatisfactory both structurally and electrically. 2) The silicones and phenyl silanes are roughly equivalent electrically, except for the lower dielectric loss of the silicone. 3) The phenyl silanes are structurally superior to the silicones, particularly after prolonged temperature cycling. 4) No one resin (at least in the form of glass cloth-reinforced laminates) is superior in all respects to the others. 5) It is likely that, in some particular radome applications in which temperatures of no more than 550°F are expected, either a silicone or one of the phenyl silanes can be used successfully in fabricating a reinforced plastic radome.

Electrical Premixes Come of Age

By Roger S. Jackson, Chief Engineer, The Glastic Corp., Cleveland 21, Ohio.

During the past year we have witnessed a significant trend in glass polyester premixes which promises to assume breakthrough proportions. This trend is based on a growing awareness that low glass content premixes are much more useful than has heretofore been recognized. These low glass, high filler materials have been successfully used in such significant applications as molded case circuit breaker housings, high dielectric class F coil forms, and track resistant circuit breaker components.

There are certain basic reasons for the great utility of glass polyester molding compounds in electrical parts and for their exceptional popularity in switchgear and circuit breaker design. Stated quickly, these are: 1) Excellent arc resistance and tracking resistance. 2) Good dielectric strength under adverse environmental conditions. 3) Superior physicals, especially toughness. 4) Good moldability. 5) Low overall cost.

Arc resistance: That polyester materials have excellent arc resistance as measured under the ASTM D 495 test has long been recognized and accounts for much of the early popularity of glass polyesters; the fact that polyesters could offer 120 to 180 seconds versus 1 to 5 seconds for phenolics at a cost competitive to or less than the phenolics initiated many applications. It is interesting to note that unfilled polyester resins are apt to test at 100 seconds or less; higher filler loadings boost this value to 180 seconds and over; proper choice of filler and filler loading can boost this value to above 220 seconds.

Track resistance: Closely allied to (but distinct from) the ASTM 495 arc resistance is the resistance of materials to tracking or carbon "treeing" under damp and/or contaminated surface conditions. Here the repeated arcing which accompanies surface leakage and discharge causes the decomposition of the plastic resins; carbon is deposited on the surface, leading to the formation of carbon

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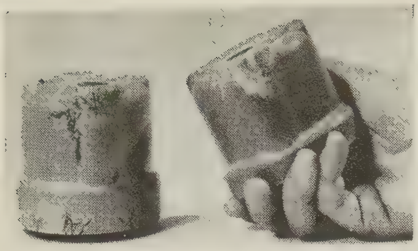
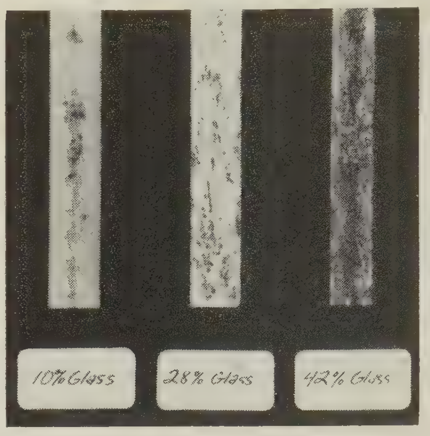


tracks or "trees." The left hand view of the figure shows a 5 kv insulator made of a conventional glass polyester compound which has been stressed at 1500 volts and placed in a chamber filled with salt fog. As the fog deposits a saline solution on the surface of the insulator, leakage currents and arcs play over the surface. In a relatively short period of time (14 hours in this case) carbon trees result as shown in the picture. The right hand view shows a second insulator which was subjected to the same test. It was made of a special track resistant polyester compound. Here the proper choice of resin and filler has provided a mechanism which prevents carbon from depositing on the surface. It will be observed after 480 hours in the chamber some erosion has taken place, but there is no carbon track.

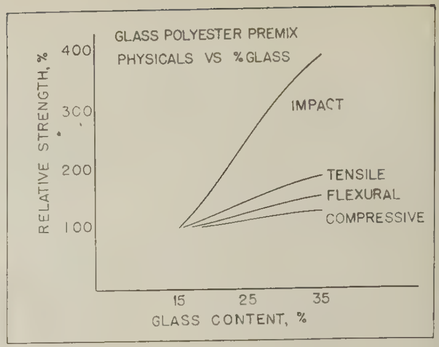
Dielectric strength: The problem of providing suitable dielectric strength in an article molded from glass polyester premix is almost exclusively one of securing a sound structure. This structure must retain its integrity during adverse environmental conditions. Samples molded and tested in accordance with ASTM D 48-54T have dielectric strengths of the order of 350 vpm—460 vpm. The fact that these dielectric strengths are usually *not* obtained in the molded article is one of the most frequent causes of disappointment for the designer. Close attention to compounding methods and to molding methods is necessary if adequate dielectric strengths in the molded part are to be obtained. Most of the problems of dielectric strength are associated with the glass fiber reinforcement and low glass content—high filler materials have inherently sounder structures.

There are three major reasons why glass fibers present dielectric problems; *first,* glass fibers cause voiding in heavy sections. The figure shows the effect of increasing glass contents on internal voiding in a ½-inch molded section. *Secondly,* it is well known that it is very difficult to secure a good bond between the resin and the glass fibers. *Thirdly,* the inherent weakness of the structure at weld lines and flow lines provides a ready point for minute cracks (sometimes not visible to the naked eye) to develop.



Impact strength and physicals generally: The very high Izod impact strengths attainable with fibrous glass reinforcement of polyester molding compounds has been one of the leading reasons for a great deal of misdirection in the formulation, preparation, and molding of glass polyester molding compounds. The root of the trouble is this: the Izod test measures the energy required to fracture the material, plus the energy required to tear the two halves of the specimen apart, plus the energy required to toss the severed half into discard. Now in electrical parts failure can normally be considered to have occurred when the first fracture occurs. With fibrous reinforcement the energy required to tear the two halves apart is quite large in comparison with the energy required to produce the first crack. (This is not true of homogeneous materials.)

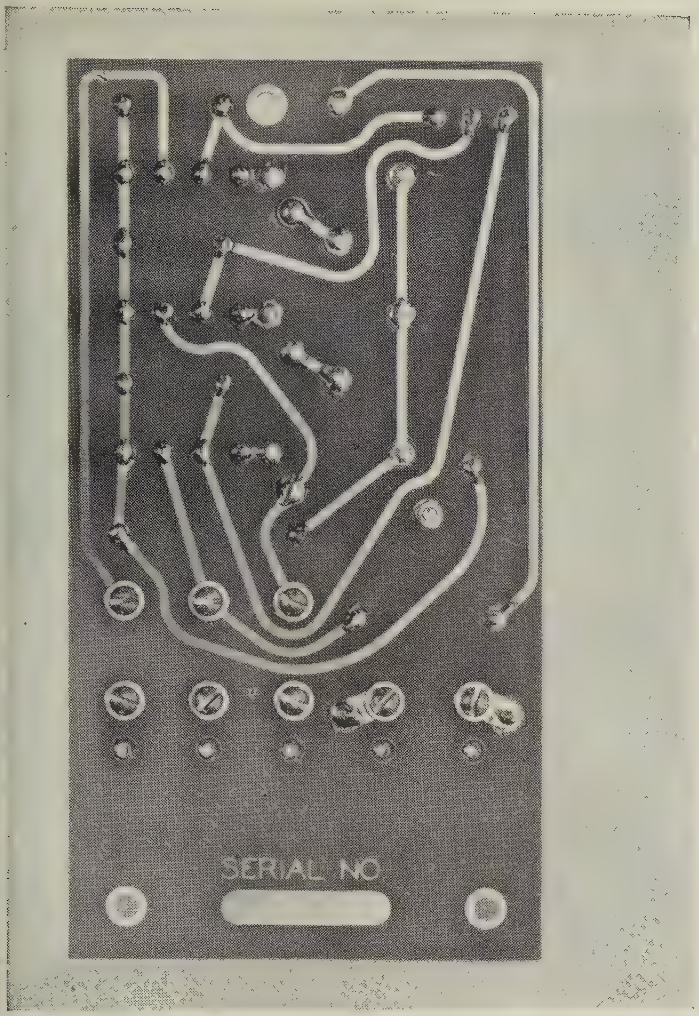
Now, if the misleading results from the Izod test are coupled with the additional fact that the Izod impact strength of the glass reinforced compound is *much* more sensitive to glass percentage than any other property, we have the basis for arguing that low glass content materials will usually do a superior job in electrical parts. The chart shows the percentage increase in physical properties which may be expected with increasing glass content. Note that the tensile, flexural, and compressive strengths increase by only a modest amount; it is the Izod impact strength which shows a spectacular improvement and we have seen that this improvement can be misleading.



Moldability: An outstanding characteristic of electrical parts from the molder's point of view is the frequent necessity to fill blind pockets (areas in the mold from which the air cannot be removed by venting or by flow of the material). Here again it is the high filler materials which do the best job.

Overall cost: It is most fortunate that the superior electrical and molding properties of the high filler materials are obtained at low cost when compared with high glass compounds. Not only is the cost per unit volume lower, but the handling and charge measuring costs are also less. To this must be added the fact that flash removal and finishing costs also tend to be significantly lower.

Coil shells for high temperature service (class B and class F) constitute one area where the newer glass polyester premixes are doing an excellent job. The figure shows such an application in Le Tourneau Westinghouse earthmoving equipment. The molded coil shell at the left replaces the old paper form shown at the right (with the winding in place) and is used to hold the solenoid which releases a spring loaded brake on electric motors ranging in size from 15



High strength-to-weight ratio. This printed wiring board for a phase failure relay (manufactured by Phase-Guard Co., Carnegie, Pa., and distributed by Stradley Engineering Co., Pittsburgh) was designed with CDF Di-Clad 28E (epoxy resin laminated with medium weave glass cloth) for high mechanical strength, very low moisture-absorption, and good insulation resistance. Details upon request.

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BOND STRENGTH—0.0014″ foil (lbs. reqd. to separate 1″ width of foil from laminate)	6 to 10	6 to 10	6 to 10	8 to 12	4 to 8
MAXIMUM CONTINUOUS OPERATING TEMPERATURE (Deg. C.)	120	120	120	150	200
DIELECTRIC STRENGTH (Maximum voltage per mil for 1/16″ thickness)	800	900	850	650	700
INSULATION RESISTANCE (Megohms) 96 hrs. at 35°C. & 90% RH (ASTM D257, Fig. 3)	500	150,000	600,000	100,000	75,000
DIELECTRIC CONSTANT 10^6 Cycles	4.5	4.0	3.6	4.9	2.6
DISSIPATION FACTOR 10^6 Cycles	0.040	0.026	0.027	0.019	0.0015
ARC-RESISTANCE (Seconds)	5	10	10	130	180
TENSILE STRENGTH (psi.)	18,000	16,000	12,000	48,000	23,000
FLEXURAL STRENGTH (psi.)	27,000	21,000	18,000	70,000	13,000
IZOD IMPACT STRENGTH edgewise (ft. lbs. per inch of notch)	0.80	0.45	0.42	12.0	6.0
COMPRESSIVE STRENGTH flatwise (psi.)	32,000	28,000	25,000	62,000	20,000
BASE MATERIAL OF LAMINATE	Paper	Paper	Paper	Medium-weave, medium-weight glass cloth	Fine-weave, medium-weight glass cloth
COLOR OF UNCLAD LAMINATE	Natural	Natural greenish	Natural	Natural	Natural

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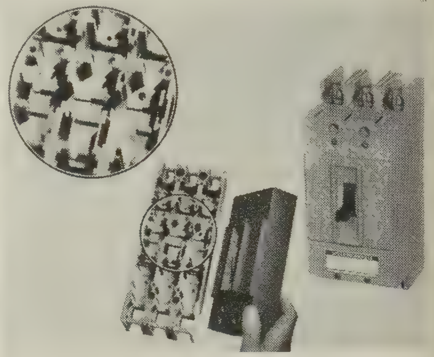
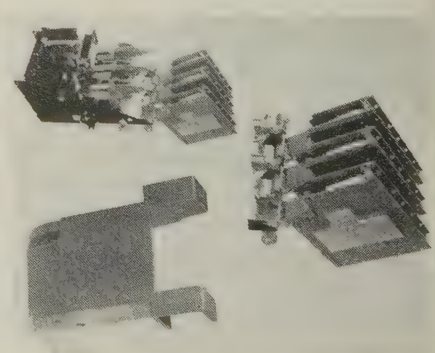
hp to 50 hp. The duty cycle in such equipment is severe—radiation from the brake and heat from the motor raises the coil temperatures into the 180°C range.

The molded case circuit breaker illustrated is another example of how the high filler content glass polyester premix can contribute in an important way to product improvement in electrical apparatus. The circuit breaker illustrated is the Mark 75 model HF molded case breaker recently introduced by the standard control division of the Westinghouse Electric Corp. Previous interrupting capacity for a 100-ampere molded case circuit breaker was 20,000 amperes (asym.) at 240 v a-c; the interrupting capacity of the Mark 75 model HF is 75,000 amperes at the same voltage. This interrupting capacity has been achieved in the same space as the previous model and at a fraction of the cost of other high interrupting capacity breakers.



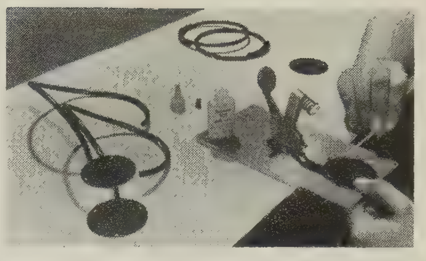
The arc chute hinge bracket shown is used in the Westinghouse type DH high voltage air circuit breaker; it insulates the arc chute from ground and at the same time provides a mechanical hinge to permit swinging the arc chute back, exposing the contact assembly for inspection and servicing, as shown in the assembly view. In order to perform properly, the hinge bracket must have good me-



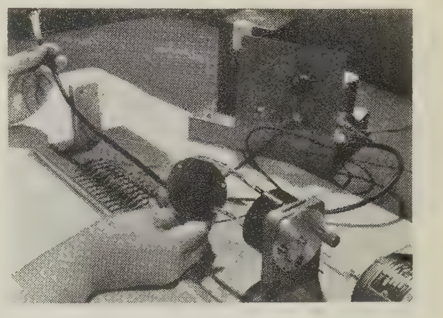
chanical properties. Since it insulates the arc chute from ground it must have good electrical properties, both originally and in service conditions; dielectric strength, power factor, and arc resistance must be examined. Present industry practice requires flame retardant insulation. And because it is continuously stressed on three phase circuits of the order of 5 kv to 15 kv and must be expected to perform satisfactorily under normal field conditions, the material should have as high a degree of resistance to carbon "treeing" as possible.

Adhesive Secures Insulating Sleeves

A recently designed shaft position digital encoder which ASCOP Division of Electro-Mechanical Research Inc., Princeton Junction, N. J., is now supplying measures about 2¼″ in diameter and approximately 1¼″ thick. ASCOP managed to pack the necessary components into the compact housing, but an unexpected complication arose—how to attach the plastic insulating sleeves containing the output circuit wires to the cover plate of the housing. This had to be done without employing a connective device which would protrude into the interior of the instrument. This restriction suggested the use of an adhesive. In production the housing cover is placed on the holding plate of a small toggle jig and the plastic tubing is inserted through the cover so that it protrudes slightly. The protruding portion of the tubing and the area of the cover plate immediately surrounding it are cleaned by wiping with a small quantity of nitromethane solvent after which a small quantity of the adhesive (Eastman 910) is applied. A "Teflon" tool attached to a toggle device flares and flattens the end of the tubing against the cover plate. Within two to three minutes a bond which reportedly is stronger than the plastic is formed. The adhesive does not require a catalyst, evaporation of solvents, or more than holding pressure.



Polyvinyl plastic tube is permanently attached to the aluminum cover plate with Eastman 910 adhesive. Plate with inserted tubing is positioned on jig and adhesive applied. Flaring tool forces the end of tube back against plate. Bond forms in two to three minutes.



Cover plate with tubing attached is installed on ASCOP's encoder, mounted on test frame.

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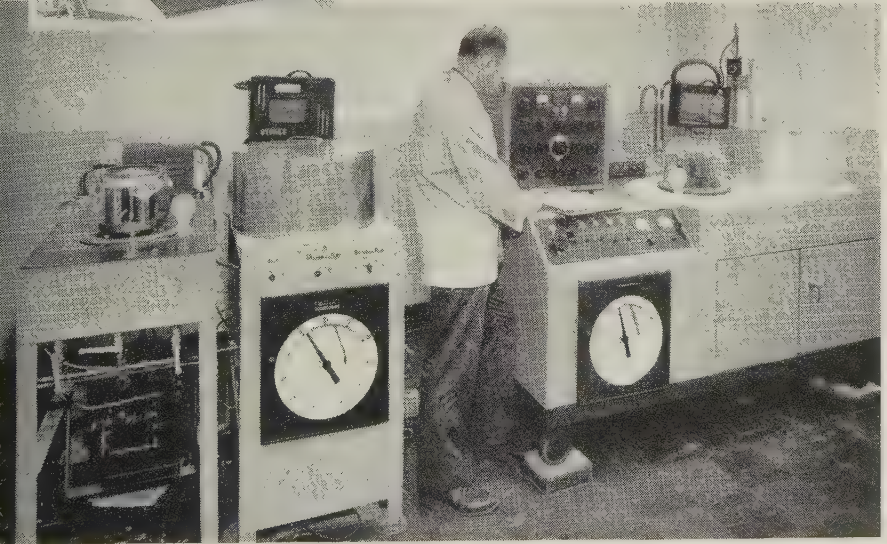

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Insulation Tests

Exposure of Polymeric Materials to Radiation

These articles by H. K. Graves, Supervisor, Electrical Insulation Section, Materials Laboratory, New York Naval Shipyard, are designed to explain the purpose, reasons, operation, meaning, and interpretation of results, etc., behind various tests for electrical insulation. Mr. Graves is also chairman of Committee D-9 on Electrical Insulating Materials of the American Society for Testing Materials.

Much work has been done in recent years on the effect of radiation on electrical insulating materials. In many of the reports and articles, essential data is omitted so that results may have little meaning for purposes of comparison. For example, temperature during irradiation is seldom given and in many cases total dose is reported with no indication of dose rate.

To make a start at standardization and give some guidance to those interested in this work, ASTM has recently published a Tentative Recommended Practice for Exposure of Polymeric Materials to High Energy Radiation, ASTM Designation D1672-59T.

Its stated purpose is to define conditions for the exposure of plastics and elastomers to high energy radiation. The properties to be measured after radiation to determine radiation effects are not defined and any property measurements during irradiation are considered to be too varied and complex for consideration in this practice. Conditions of irradiation are specified but not the kinds or forms of specimens, so that the effect on any property may be determined by the use of appropriate specimens and test methods.

The practice describes five types of exposure, as follows:

Procedure A—Exposure at Ambient Conditions.
Procedure B—Exposure at Controlled Temperature.
Procedure C—Exposure in a Medium other than Air.
Procedure D—Exposure Under Load.
Procedure E—Exposure Combining Two or More of the Variables Listed in Procedures A through D.

The practice is intended to cover gamma, or X-radiation, electrons or beta radiation, neutrons, and mixtures of these such as reactor radiation. It is not intended to cover heavy charged particles (alphas, protons, etc.).

The procedures outlined are intended to standardize exposures but were made flexible enough so that (it is hoped) a large variety of conditions may be met. To help the experimenter to utilize the flexibility in the procedures, a discussion of the kind of changes which will occur and the conditions that will affect these changes is provided. This discussion is intended to provide a minimum background only and states, in part, that exposure to radiation results in extensive changes in the nature of high polymers, which owe their unique properties to chemical linking into giant molecules of chain or net structure. These structures may be crosslinked by radiation into rigid, three-dimensional networks or in other cases, may be cleaved into smaller molecules to weaken the material. It notes that in all cases some low molecular weight fragments are produced and, if exposures are large enough, general decomposition results.

The discussion states that the first result of high energy radiation on polymers is the formation of free radicals or excited molecular fragments. If these are formed faster than they are annihilated, reactive species accumulate and reactions may continue for days after radiation has stopped. Time between irradiation and testing is therefore important.

Since the changes in molecular structure depend on the respective rates of recombination, crosslinking, or cleavage of molecular fragments, and these rates are affected by mobility of molecular fragments, temperature can strongly affect results.

Either radiation intensity or dose rate must be specified since the concentration of reactive species will vary with the rate of absorption of radiation.

Oxygen tends to terminate radicals produced in the irradiated material, and therefore specimen thickness and diffusion rate affect results. It is necessary to state whether irradiation and storage after irradiation were carried out in the presence of air and if so, the air supply should be sufficient so that oxygen is not depleted.

The discussion states that neutron bombardment produces densely ionized tracks in the specimen whereas photons or electrons produce diffuse ionization and possibly different effects.

The choice of exposure level for testing is difficult because some materials require many times as much energy to form one crosslink as is needed for another. The resulting change in property may progress at different rates, with some materials changing rapidly once a change has been initiated. Irradiation should be carried out at several fixed levels of property changes to establish a rate.

The discussion warns that, although most common radiation sources will not induce radioactivity in specimens, exposure in a reactor will, and fillers or impurities may retain their radioactivity and so create a handling problem.

The practice suggests that standard ASTM specimens be used where possible but that in any event, irradiated and non-irradiated specimens shall be of the same size and shape.

Sections on conditioning of specimens and sections describing each of the five procedures listed above are included.

A general guide for dose rates is

included for three specific categories of high energy radiation where past experience has shown approximately equal effects for equal total exposure:

Radiation	*Rads per hr*
Gamma, X-radiation	10^5 to 10^7
Electrons, beta	
Radioisotopes	10^5 to 10^7
Accelerators	10^8 to 10^{10}
Reactor (neutrons and gamma)	10^5 to 10^7

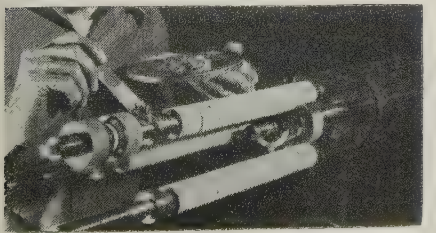
For engineering purposes, the best correlation of radiation effects in polymers is made on the basis of energy absorbed in the specimen. The preferred unit is the rad, which is defined as 100 ergs of absorbed energy per gram of material. Several methods are given for measuring dose. One is a chemical dosimeter and is described in a new ASTM Designation D1671-59T. Others mentioned are an ionization chamber, change in physical property of a material, or by calorimetry.

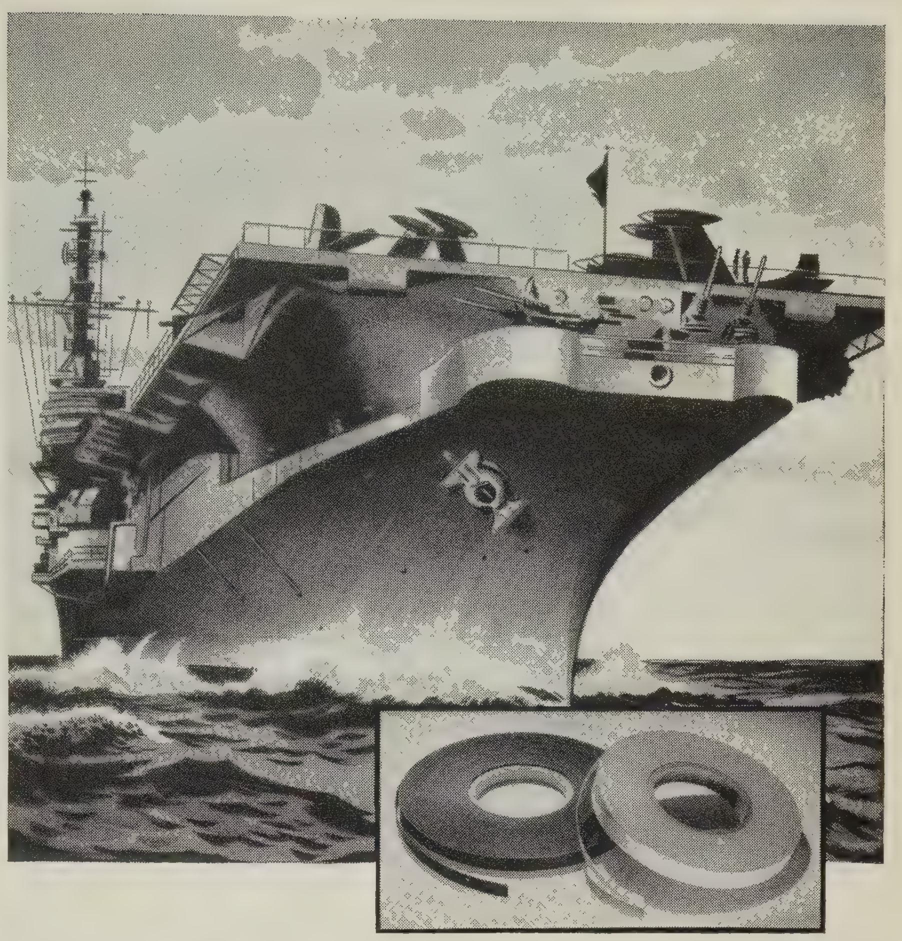
Kind of radiation and energy or energy spectrum of radiation must be specified and the energy or energy spectrum may be specified by giving the source of radiation. For reactor radiation, the problem is more complicated and procedures have not yet been standardized.

The practice gives a very complete list of things which must be reported under exposure procedure, under irradiation conditions, specimen description and material description. If followed, it should make irradiation work on insulating materials of far more use and general interest.

Epoxy Cement For Tight Seals

Epoxy resin aluminum cement is being used to create an exceptionally tight seal for washers on the terminal conductors of a 75 kw electrical resistance heater. The compound is Metalset A-4, made by Smooth-On Manufacturing Co., Jersey City, N.J.





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for shipboard cable application

Formulated on a patented asbestos base paper, Novabestos high-temperature tapes are especially suitable for marine cable insulation. Novabestos tapes have superior qualities of heat, water and corrosion resistance, excellent dielectric strength, good handling strength; and cost per unit of area is low.

Novabestos tapes are ideal for Class B or Class H insulation. Available in thicknesses from .0025 to .025 in. in various combinations of asbestos and glass fibers.

Style 7503. Especially suitable for use as impervious sheath in shipboard cables, meeting Military Specification MIL-C-915A. An asbestos sheet reinforced with glass yarns for high tensile strengths and impregnated with PVA. Tape thicknesses of .010 and .015 in.

Style 7504. For primary insulation of cables. PVA-impregnated asbestos with high percentage of glass in the base mix. Thicknesses of .008, .010, .015 in.

Style 7505. Same as Style 7504, except impregnated with asphalt for moisture and rot resistance. Thicknesses of .008, .010, .015, .020 in.

Style 7535. Glass reinforcing yarn gives Novabestos Style 7535 adequate tensile strength for high-speed taping head applications. Asphalt impregnated. Thicknesses of .011, .016, .020 in.

R/M Novabestos insulating tapes, widths of ½ to 3½ in., are wound on cores of 1½, 3, 4 and 6 in. Write for complete technical data.

R/M

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RAYBESTOS-MANHATTAN, INC.
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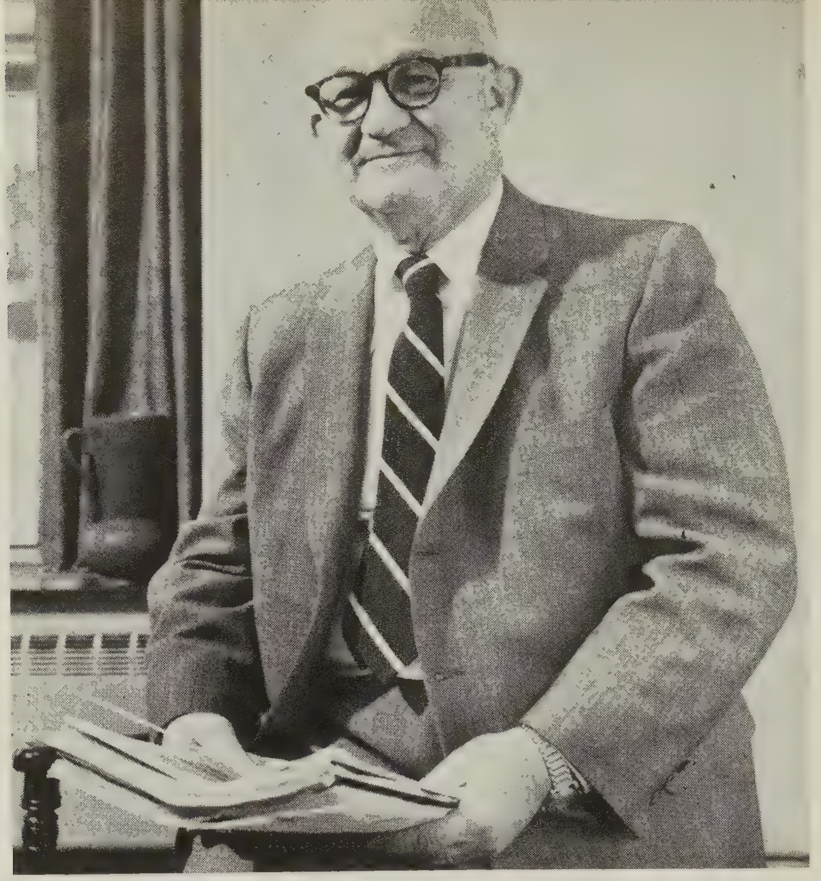

Men in Insulation

Ernest O. Hausmann

Vice President in Charge of Engineering, Research, and Purchasing, Continental-Diamond Fibre Corp., Newark, Del.

This feature is devoted to a leader in the insulation field—his work, background, accomplishments, traits, and goals. It is well-deserved recognition of significant contributions made to the industry. It is also hoped that occasional biographical sketches such as this will provide encouragement to other men concerned with insulation.

•

Important technical contributions and untiring service to the electrical insulation industry highlight the life of Ernest O. Hausmann, vice president in charge of engineering, research, and purchasing for Continental-Diamond Fibre Corp. His contributions have aided the progress in the areas of testing, processing and manufacturing techniques, quality control, and uniform performance of electrical insulation.

With other outstanding men in this field, Hausmann has ceaselessly striven for higher quality in standards for many electrical insulating materials. Through work on industry committees and industry-government committees, and through keen interest and personal development of tests, he has persistently promoted the establishment of standards for the field.

The aggressive, though extremely pleasant and patient 52-year-old executive—better known to his friends as "Ernie"—derives great satisfaction from his work. He says, "It is always a great pleasure to work with design problems involving insulating materials. I like to see how a new insulating material, or a modified material, can become the solution to a tricky design problem. The tougher the problem, the better I like it." This preoccupation with tough problems is illustrated by a humorous incident that happened some years ago. CDF had a problem involving mechanical strength of a molded item. This problem had been given considerable attention by production, process engineering, and research. Despite concentrated efforts, they could not seem to solve it. Driving between his home, which was then in Norristown, Pa., and headquarters at Newark, Del.—a daily trip—Hausmann had ample opportunity to consider this problem along with many others. One night while driving to Norristown he became seriously engaged in thought about the problem; in fact, so seriously preoccupied that he drove through a red traffic light which he was shortly told by a traffic officer had been red for 40 seconds. He related his story to the traffic officer, who heard it with consternation and who then stated, "Damned if I have ever heard one like that." However, he gave Hausmann the benefit of the doubt. The story was true. Hausmann's ideas jelled, and this important problem was solved.

After formal training at both Drexel Institute of Technology and the University of Pennsylvania as an electrical engineer, Hausmann began his career with the Continental-Diamond Fibre Co., then the Diamond State Fibre Co., 31 years ago as engineer in charge of mechanical and electrical testing. During his early years in the laboratory he developed and carried out tests on all types of electrical insulation, particularly vulcanized fibre and laminated thermosetting plastics and molded products.

While developing these tests on CDF materials, Hausmann developed a method of testing the flammability of rigid materials, and coauthored a paper on this subject. This test later became a standard ASTM Test Method.

As a member of the American Society for Testing Materials, as early as 1932 he began to play an active part in the programs of Committee D-9 (electrical insulating materials) and later Committee D-20 (plastics). At various times he served both of these committees by being chairman and secretary of a number of their subcommittees and sections.

Many novel test methods were developed under Hausmann's direction while he was serving on D-9 Subcommittee 3, Sections 3, 5, and 9 (mechanical and physical tests on insulating materials). Likewise, while serving as chairman of Subcommittee VII, Section F, of Committee D-9 (measurements of power factor at ultra high frequencies), Hausmann assisted in developing tests that enabled both manufacturers and users to test and classify insulating materials by reliable, uniform testing methods. He coauthored a paper covering this extensive work which was published in ASTM 1951 Proceedings, pages 1152-1172.

For a number of years he was chairman of Subcommittee 6 of Committee D-20 on plastics, where he helped to prepare specifications for industrial laminated thermosetting plastics as well as decorative laminates. These were the first specifications developed for this class of products in ASTM.

By 1936 Hausmann had become laboratory director of CDF in Bridgeport, Pa., and was in charge of all that plant's quality control, process engineering, and some research.

In 1943 an important NEMA testing project was started at Johns Hopkins University. This project, in part, worked out test data on laminates for high and low temperature military applications, and developed data on thermosetting laminates for later revision of industry and military standards and specifications. Hausmann played an important role as a member of this project.

In 1943 Hausmann was made CDF's director of technical control—this included quality control, process engineering, and technical service. In recognition of his past contributions to the insulation industry on the committees of various technical groups, he was made official company representative to all technical and professional societies with which CDF was affiliated.

During the early years of World War II, Hausmann participated very actively in the coordination of the work of NEMA, the American Standards Association, and other industry and military groups in the establishment of military specifications for thermosetting laminates. New standards for thermosetting laminates using phenolic and melamine resins were developed by the NEMA Advisory Technical Committee (Laminated Products Group) during the period (1942-1945) when Hausmann served as chairman. He also worked with a joint industry-government group in the development of glass-melamine laminates for electrical insulation.

Another notable achievement in Hausmann's activities during World War II was a large reduction in CDF's use of meta para cresol used in the synthetic varnishes it produced. As the war threatened in 1939, CDF recognized the probability of a restriction on the meta para cresol used largely in the production of electrical grades, particularly punching stock grades of laminates. Through research efforts CDF was able to significantly increase the use of phenol (less critical supply), and greatly reduce the use of cresol which was very critically in short supply. The War Production Board was assisted by this change.

In 1952 Hausmann was made technical director of CDF. In that same year he was leader of the United States delegation to the International Standards Organization Conference on Mica (150 D-56) at Columbia University. The work of this conference resulted in some progress toward international standards for raw mica. Hausmann led the U.S. delegation while serving as chairman of Subcommittee IX of Committee D-9, ASTM, which he had chairmanned for about eight years (1943-1951).

Late in 1953 he was named assistant to the president of his firm, still retaining his title of technical director. With the Budd company's acquisition of CDF in July 1955, Hausmann was appointed a vice president. At this time he served in the areas of research, engineering, manufacturing, and purchasing. It was he who directed CDF's development of exceptionally high-heat-resistant materials such as the asbestos and glass-filled phenolic laminates and molding compounds that are used in components for guided missiles where temperatures up to 5000° F are encountered for short periods.

He holds several patents, having worked with CDF's technical service, research, and sales departments to promote and engineer many new applications for plastics and insulating materials. He is responsible for a fast-

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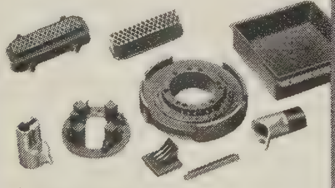

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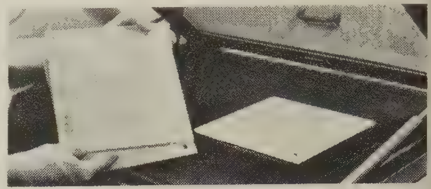
curing phenolic resin which has made possible a considerable reduction in processing time for certain laminated products.

At the present time Hausmann is active in numerous NEMA technical committees. He is a member of the Manufactured Electrical Mica Section; vice chairman of the Varnished Fabrics and Paper Section; technical chairman of the Vulcanized Fibre Section; a member of the Advisory Technical Committee of Varnished Fabrics and Papers, Vulcanized Fibre, and Laminated Products groups; and is the principal NEMA representative on Committee D-9 of ASTM, as well as NEMA representative on the American Standards Association Sectional Committee C-59. In addition to representing his company in ASTM, he is the principal member on ASTM Committees D-6, D-9, D-11, D-13, and D-20. Hausmann is also a member of the ASTM Philadelphia District Council, a member of the Committee on Award of Merit, and has just recently been appointed chairman of the American Ordnance Association Committee on Plastics.

Hausmann has written many papers and given many talks on plastics and insulating materials which have been published by, or presented to, various trade journals, ASTM, SAE, and other societies. He has traveled widely in the United States and abroad representing CDF in this field. He is a member of the American Institute of Electrical Engineers, Franklin Institute, and the Society of the Plastics Industry.

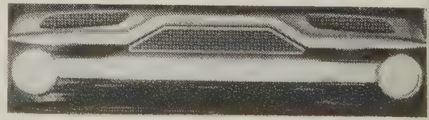
In spite of all his professional activities, "Ernie" finds time to take an active part in church and community affairs as well as for such leisure activities as photography, swimming, fishing, and boating. He is a member of Christ Church, Norristown, serving as an elder and as a member of the board of trustees. He is also active in Masonry. Ernie and his wife Dorothy live in Newark, Del. but are presently building a new house in Glen Farms, Md. His son, Ernest Frederick, is a high school senior and is looking forward to college entry this fall.

Circuits Transferred By "Paper" Negatives



The use of "paper" negatives to transfer circuitry patterns onto copper clad glass-epoxy laminated boards is said to reduce alignment and damage problems and to insure dimensional stability of the negative itself. The reversed image of the circuit is transferred onto a thin, translucent paper stock, and bonded to a rigid piece of transparent plastic. The paper negative, with its backing of plastic, is more stable dimensionally and less susceptible to developing scars from rough handling by workers than is a film negative. Use of plastic backing material also permits automatic alignment. Circuit boards may be jig-drilled with alignment holes at the corners prior to being sent to the printing laboratory. Pins inserted in the corners of the plastic negative support correspond with the holes in the board, and hold the board firmly in alignment during the photographic process. The process is now a standard procedure at Librascope Inc., Glendale, Cal.

Fluorescent Headlights



A compact lighting system with a brightness level 338 percent greater than any fluorescent unit commercially available has been demonstrated by Sylvania Electric Products Inc. Called the Sylvania Controlled Powerbeam System, the new unit throws a narrow band of light for a considerable distance with a minimum amount of glare. One of the potential applications reportedly possible is its use as a linear fluorescent automobile headlight. The experimental headlight shown in the photo extends across the grille of a car between conventional incandescent headlamps.

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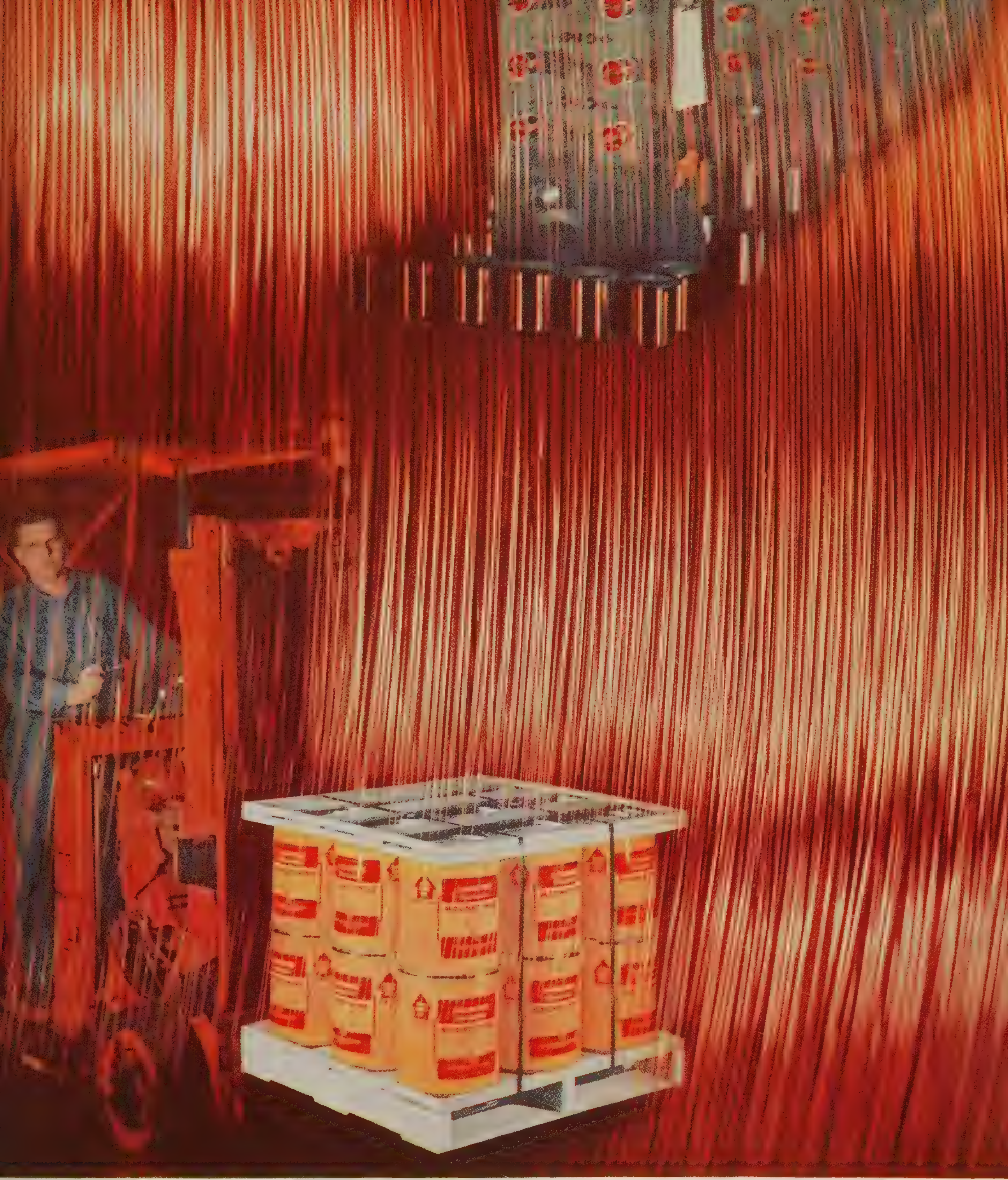

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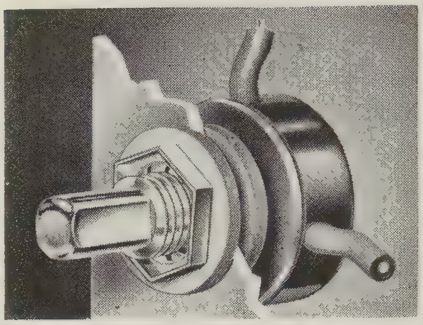
New Class B Insulation Has High Dielectric Strength Under Stretch

"Teraglas" is a new flexible insulating material consisting of a base fabric woven from polyester (polyethylene terephthalate or "Dacron") warp yarns and continuous filament glass filler yarns, and coated with an improved varnish. Exceptional dielectric strength properties under elongation are claimed. Teraglas is furnished in two thicknesses, .010″ and .012″, in tapes, in full width rolls (36″), or in sheets. It is said to withstand class B (130°C) operating temperatures. The high dielectric strength is expected to enable use of thinner sections or fewer layers of Teraglas in comparison to varnished cambric, and consequently (at comparable prices) to provide a significant saving in production costs while permitting up-grading to class B temperatures. Applications include use for insulating motors, generators, transformers, cables, switchgear, busbars, and other apparatus and equipment where resiliency and high dielectric strength are desirable. Free data sheet and samples available. Natvar Corp., Randolph Ave., Woodbridge, N.J.

Print No. Ins. 101 on Reader Service Card

Pressure-Sensitive Adhesive on Fibre and Plastic Insulations

SF-17, a new pressure-sensitive adhesive backing now available on certain fibre materials and fabricated parts, is supplied covered with silicone-coated release paper and holds parts to components during assembly in blind spots or hard-to-reach areas. Its bonding qualities are said to permit adherence to almost any solid surface. SF-17 adhesive backing can be furnished on vulcanized fibre in sheets of 1/32″ thickness or more, as well as on "Spauldite" (thermosetting plastic) in sheets, strips, and fabricated parts. SF-17 has been found especially effective when used to back washers and other insulating pads in electrical applications. Photo shows SF-17 backed washers used in a push-pull electrical switch mounting for insulating and locking of the nut. SF-17 speeded production by holding the washers in position until assembly. Spaulding Fibre Co. Inc., 310 Wheeler St., Tonawanda, N.Y.



Print No. Ins. 102 on Reader Service Card

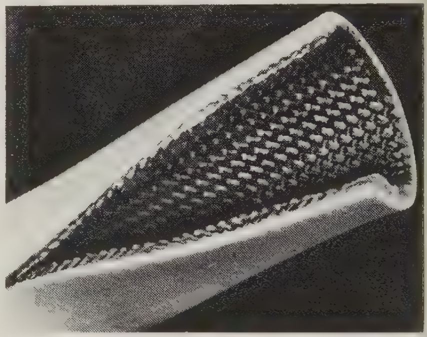
Flexible Printed Circuit Base

A new material for printed circuits consisting of boards laminated from "Enrad" II and fiber glass cloth is claimed to form a thin, yet strong base material having outstanding temperature, moisture, and dielectric strength characteristics for VHF and UHF applications. When laminated with copper, printed circuit boards are stated to readily withstand a 20-second solder-dip test as well as a 5 to 9 lb peel-back test. The high strength of the boards reportedly permits them to be made as thin as 0.010″ and to bend in small diameters to fit tight space requirements without cracking or crazing. In addition to flexible and semirigid types, Enrad II is also available as a thicker super-rigid material which permits printed circuit boards to be used as integral supporting members. Enrad II printed circuit boards are made from specially irradiated polyolefins designed to resist further radiation and to maintain exceptionally uniform properties. Enrad II is a thermoset material which exhibits little or no cold flow. Samples and technical data available. Enflo Corp., Fellowship Road and Route 73, Maple Shade, N.J.

Print No. Ins. 103 on Reader Service Card

Sleeving Eliminates Damage In Product Assembly

A new extrusion-coated silicone rubber insulating sleeving with a basic braid of inorganic fiber glass, called "Ben-Har" 1151, uses a new silicone rubber formula, durasyl, which reportedly is highly resistant to abrasion. It eliminates fingernail damage and similar product assembly hazards. Ben-Har 1151 is said to expand four sizes larger than its original diameter, fitting easily over irregular connections without end fray or coating fracture. It recovers shape indefinitely. Snug fit eliminates vibration. The new product meets specifications for electrical insulating sleevings covered by MIL-I-18057A, and NEMA Type 5. It is rated for continuous operation at 220°C. The low temperature brittle point is below —85°C. Ben-Har 1151 is made in even-numbered AWG sizes 24 to 8, and all AWG sizes 8 to 5/8″. Data sheet and production testing samples available. Bentley-Harris Manufacturing Co., 400 Barclay St., Conshohocken 6, Pa.



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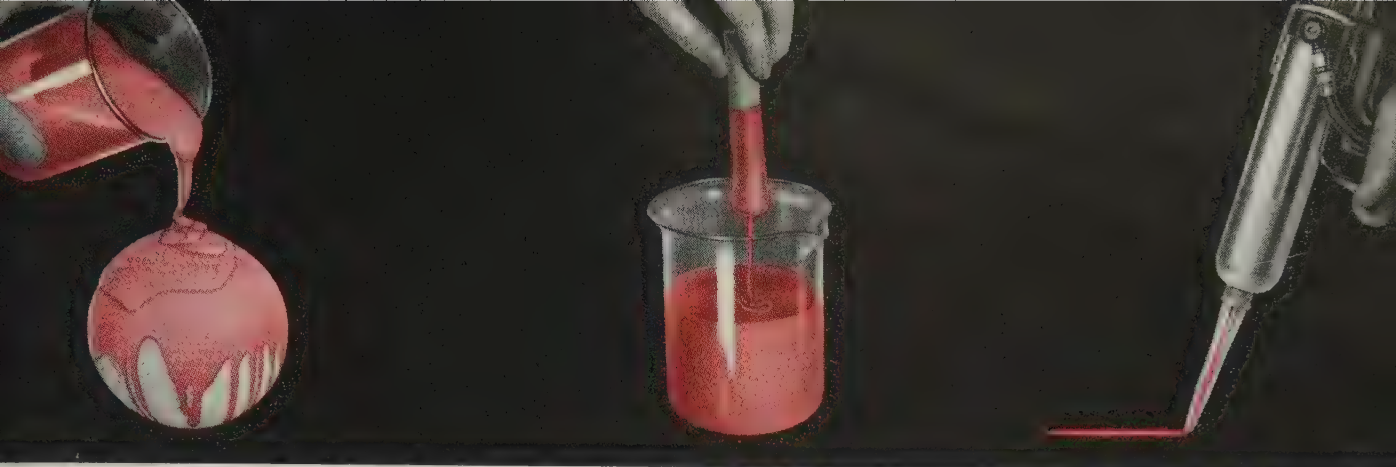
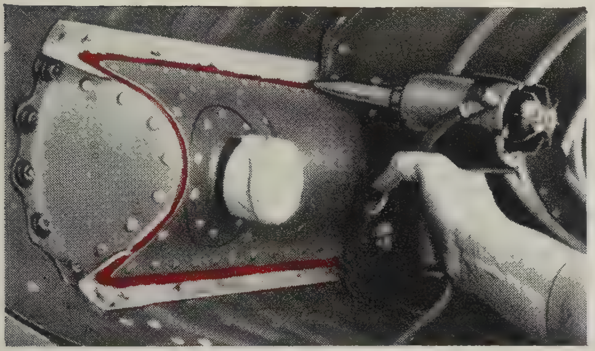
Fiber Glass Alumina-Polyester Impact Molding Compound

Parts molded from a new impact molding compound, a fiber glass alumina-polyester called "Resistrac," reportedly resist the formation of carbon tracks when operating under voltage stresses in extreme conditions of humidity and contamination. Subjected to the salt-fog test, molded parts

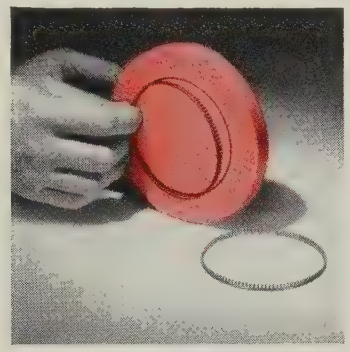


General Electric RTV silicone rubber

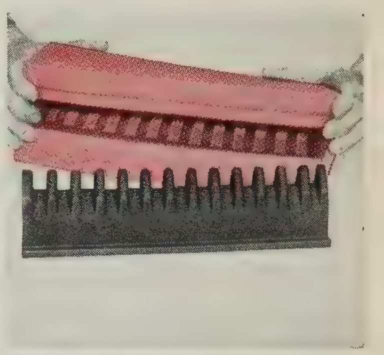
New liquid rubber cures without heat, useful from — 70 F to + 600 F, ideal for sealing, electrical insulation and flexible molds.



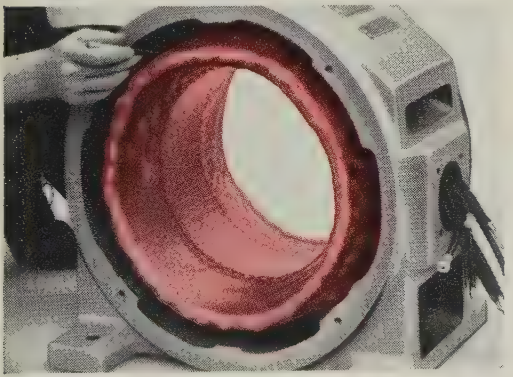
HEAT RESISTANT SEALING, such as shown on this Douglas DC-8 Jetliner, is made possible with RTV (room temperature vulcanizing) silicone rubber. RTV cures without application of heat; won't shrink (no solvents); forms no voids. It has excellent bond strength, plus resistance to high temperatures, moisture, weathering, ozone, aircraft fuels and solvents.



PRECISION MOLDING of prototype and engineering models and replacement parts is simplified and improved with RTV flexible mold material. G-E RTV's low shrinkage permits close tolerances and fine surface detail.

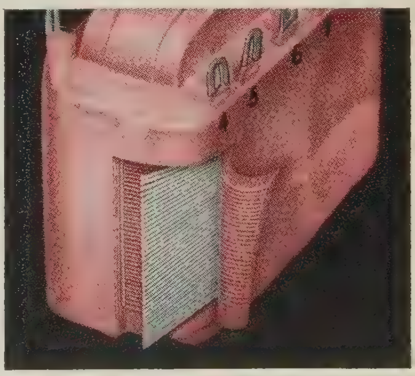


LOW-COST TOOLING with flexible RTV mold material offers added savings in time and expense. RTV's "built-in" release agent provides easy removal of this epoxy coil-winding form from mold. Total cost reduced 81%, delivery time 90%.



ENCAPSULATION OF STATOR WINDINGS, introduced by General Electric motor departments, extends service life of motors. RTV's resistance to moisture and other contaminants enables these dripproof motors to meet certain applications formerly requiring enclosed units.

POTTING OF AIRBORNE EQUIPMENT provides protection from high altitude arc-over and corona as well as vibration and moisture. RTV silicone rubber protects this cathode ray tube up to 70,000 feet.



RTV COIL IMPREGNATION enables this Hughes Aircraft Co. transformer to provide top performance at 250°. Unlike other insulations tried, G-E RTV compounds proved successful both for coil impregnation and full encapsulation.

For application data and samples of General Electric RTV silicone rubber write Section M-414, General Electric Company, Silicone Products Department, Waterford, New York

GENERAL ELECTRIC

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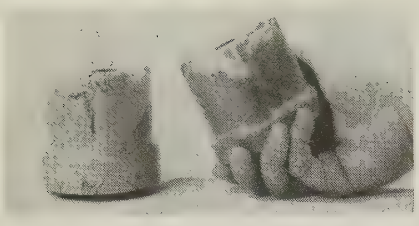


of Resistrac (right in photo) are claimed to have tracking resistance at least 25 times that of conventional glass polyester (left in photo) and do not exhibit the spalling common to ceramic-type materials that have suffered thermal shock caused by arcing. The molding compound is flame-resistant as well as track-resistant. The Glastic Corp., 4321 Glenridge Rd., Cleveland 21, Ohio.

Print No. Ins. 105 on Reader Service Card

Polyester-Treated Fabrics and Tapes For Forming Insulation Shapes

A new line of B-stage polyester-treated fabrics and tapes for use as intermediates in rolling insulating tubes and in forming or molding shapes or contours for mechanical and electrical equipment employ a variety of bases, including glass and synthetic fabric, asbestos, and asbestos-glass mat. Fully catalyzed, they reportedly can be stored at room temperatures for at least six months without deterioration and are as easily handled as standard glass-base fabrics. "Micarta" B-stage polyester-treated glass fabrics (Grades TT-9451 and M-41524-BV) are recommended for formulating rigid laminates having high moisture resistance and stable physical properties at elevated temperatures. Good bonds to many materials at relatively low temperatures and pressures are claimed. Micarta Grade TT-9453 B-stage polyester-treated glass fabric is recommended for barrier tube rolling and general low-pressure banding applications. Micarta Grade M-41424-FA is an epoxy-treated asbestos-glass fiber mat intermediate suggested for insulating field coils requiring class B performance. Its base is asbestos paper reinforced by glass fibers. Use of the epoxy resin affords high bonding strength with copper and class B heat resistance. Westinghouse Electric Corp., Micarta Div., Trafford, Pa.

Print No. Ins. 106 on Reader Service Card

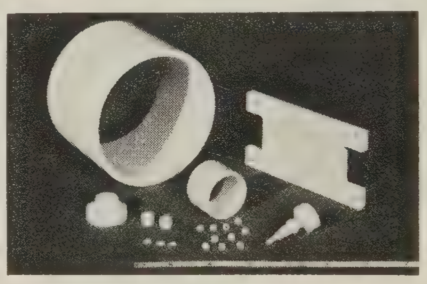
Improved Vinyl Compound for Wire and Cable Insulation

"Opalon" 1040, an improved vinyl compound for wire and cable insulation, is said to have outstanding oven aging characteristics and to conform with the National Electrical Code THW classification. (The THW category provides for a thermoplastic insulation which is flame-retardant, moisture- and heat-resistant, and suitable for service at 75°C in both dry and wet locations.) Good electrical properties, and excellent processing characteristics are also claimed. Plastics Div., Monsanto Chemical Co., Springfield, Mass.

Print No. Ins. 107 on Reader Service Card

Beryllium Oxide Insulating Parts Retain Strength at High Temperature

New dense ceramic electrical insulating parts made of beryllium oxide compositions are said to retain their strength characteristics at elevated temperatures, to exhibit excellent heat transfer properties, and to have low dielectric constant and loss factors. Parts reportedly can be made to extremely close tolerances for the electronics industry. Coors Porcelain Co., 600 Ninth St., Golden, Colo.



Print No. Ins. 108 on Reader Service Card

Insulation and Protective Coating For Heavy Duty, High Temperatures

A high temperature, heavy-duty service, insulation and protective coating, "HumiSeal" type 1H34, is stated to be extremely practical in many military applications and particularly in those where radioactive environment is involved. A one-component system with a silicone resin base, the material reportedly is characterized by a six-month pot life and excellent electrical properties at temperatures above 400°F. It may be applied by spray, dip, or brush. Columbia Technical Corp., 61-02 31st Ave., Woodside 77, N.Y.

Print No. Ins. 109 on Reader Service Card

New Asbestos Paper-Polyester Film Electrical Insulating Material

A new series of asbestos paper-polyester film composites, called "Chasebestos" 150, incorporates a new 100% pure asbestos fibre paper, a new synthetic rubber binder, and new binding agents. Ability to withstand high temperatures without deterioration and high moisture resistance are outstanding features claimed. The material is also said to be more compatible in systems because of better cohesion of the binder and bonding agents in varnishes and solvents. The new binder, in addition, reportedly permits greater elongation and flexibility, with less cracking on bend. Chase-Foster Inc., 34 Ormsbee St., Providence, R.I.

Print No. Ins. 110 on Reader Service Card

Fluorinated, Moisture-Resistant Electrical Protective Coating

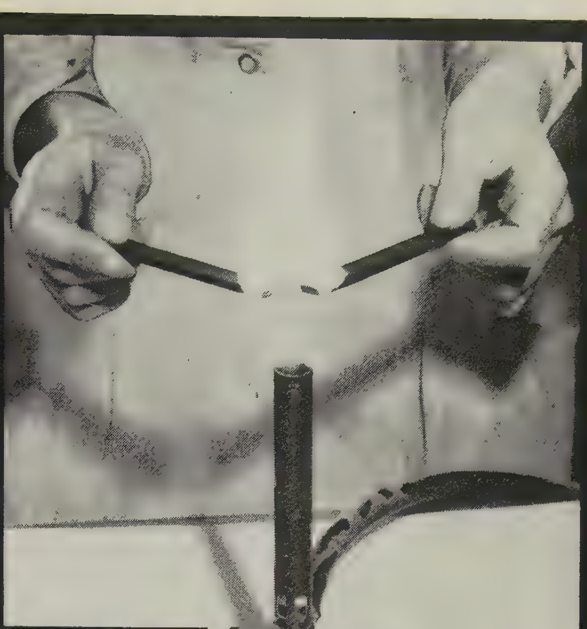
New fluorinated thermosetting protective coating material No. 1510 is designed to protect electrical parts and other materials from water and chemicals. Excellent electrical insulating properties and arc resistance are reported. Suggested applications include use on printed circuit boards, terminals, headers, pothead coverings, semiconductor header leads, antennae spacer insulators, and ignition coil and harness water proofing. Excellent adhesion, elongation, flexibility, fungus resistance, and organic solvent resistance are also claimed. The manufacturer states that no changes in characteristics have been observed over long exposure periods in sunlight, elevated or very low temperatures, and in a wide variety of strong reagents. The material may be applied by spraying, brushing, or dipping, and can be cured at either room or at moderate elevated temperatures. The film is said to have a dielectric strength of 850v/mil. Applied Plastics Co. Inc., 130 Penn St., El Segundo, Calif.

Print No. Ins. 111 on Reader Service Card

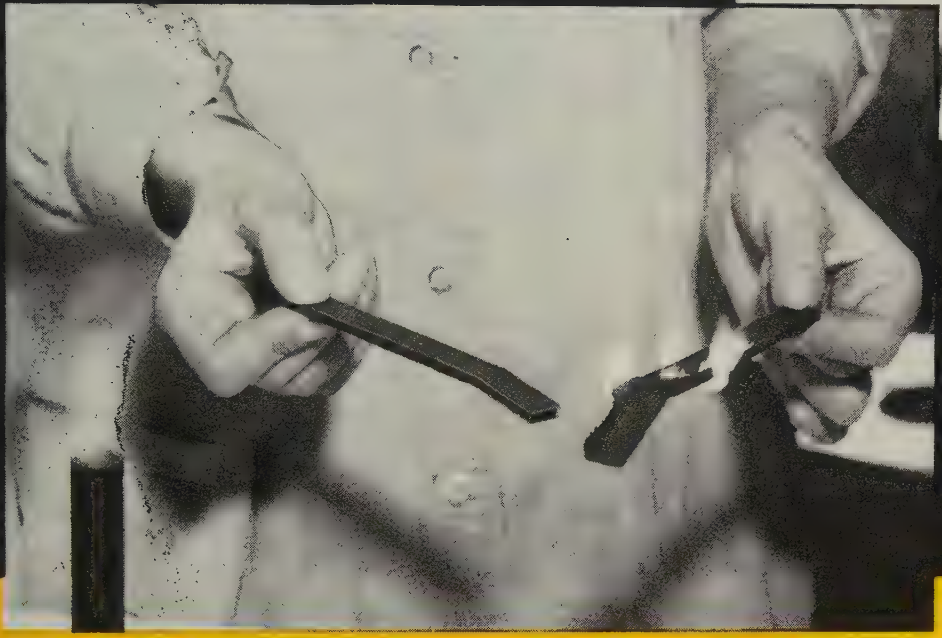
Synthetic Rubber Based Solutions For Coating and Wire Insulation

A variety of new colored and black solutions based on "Viton" synthetic rubber (a fluorine-containing elastomer) reportedly have excellent re-

NEW FLAME-RESISTANT EPOXY



When set directly in the flame, both the Epoxy #1202 (left) and the conventional epoxy are ignited.



When removed from the flame, only the conventional epoxy continues to burn. The Epoxy #1202 is flame-resistant!

Now there's another important addition to EPOXY PRODUCTS' famous E-Pak epoxy system — a flame-resistant epoxy, Epoxy #1202. Within one second after being removed from direct contact with a flame, Epoxy #1202 is completely extinguished! What's more, E-Cases of molded Epoxy #1202 have successfully been tested for 1000 hours at 200°C as packages for electronic components.

The new flame-resistant epoxy meets the most stringent requirements of the electrical/electronic industry. It is excellent for such applications as computers, where flame-resistant properties are all-important. And, of course, the new Epoxy #1202 makes the famous E-Pak encapsulation system for electronic components even more effective.

Flame-resistant Epoxy #1202 is available in E-Case shells and other custom-molded parts, or as a liquid epoxy resin.

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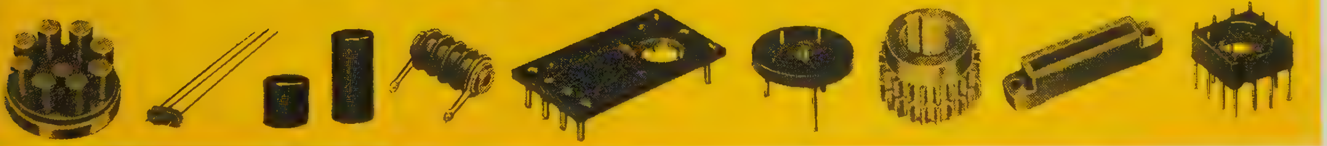

Belden Lead Wire is easy to strip

and solders readily without insulation shrinkage.

maintains its color identification through baking cycles and impregnations.

reduces process inspection.

gives long service life.

Complete stock line of UL voltage and temperature rated wire shown in Catalog L59.

3-2-9

Belden
WIREMAKER FOR INDUSTRY
SINCE 1902
CHICAGO

BELDEN . . . one wire source for everything electrical and electronic

magnet wire • lead wire • power supply cords • cord sets • portable cordage • electronic wire • automotive replacement wire and cable • aircraft wire • electrical household replacement cords

sistance to heat, ozone, oils, fuels, solvents, and other fluids. Suggested applications include insulation coatings, wire insulation, color-coding, and many other uses where molding is not desirable or physically possible. Additional information and price lists on request. Pelmor Laboratories Inc., 401 Lafayette St., Newtown, Bucks County, Pa.

Print No. Ins. 112 on Reader Service Card

High Temperature Polyurethane-Based Electronic Molding Compound

A new, high temperature, polyurethane-based electronic molding compound, Pro-Seal 786, is a black two-part compound which reportedly operates at —65°F to +350°F, and exhibits good physical and electrical properties. High tear strength where essential in molded "Y" or multiple finger breakouts and cured Shore A hardness of 60 ±5 are also claimed. Available in preweighed kits or premixed frozen tubes for field use. Coast Pro-Seal & Mfg. Co., 2235 Beverly Blvd., Los Angeles 57.

Print No. Ins. 113 on Reader Service Card

Low Viscosity RTV Silicone Rubber for Potting, Encapsulating, Impregnating

A new, low-viscosity, room temperature vulcanizing silicone rubber, RTV-11, reportedly offers a lower viscosity than has ever before been available in any silicone rubber compound. RTV-11 is said to cure at room temperature to form a strong, resilient rubber which has good electrical properties and excellent resistance to temperature extremes, ozone, weathering, and aging. This new grade contains no solvent and has a typical viscosity of 120 poises. It is stated to be easily pourable in and around irregularly shaped configurations and to be especially suited for potting, encapsulating, and impregnating of electrical and electronic components. One suggested application is its use as a protective conformal coating over printed circuit boards. Silicone Products Dept., General Electric Co., Waterford, N.Y.

Print No. Ins. 114 on Reader Service Card

Heat and Arc Resistant Asbestos/Phenolic Molding Compound

Featuring a heat distortion point of over 500°F, a new asbestos-reinforced

"For Maximum Performance"

NEW ENGLAND MICA

Y-26 HIGH HEAT MICA PLATE

Y-26
HIGH HEAT
MICA PLATE IS
COMPLETELY
INORGANIC,
HAS HIGH
REFLECTIVE
VALUE
AND IS
RESISTANT TO
650° CENTIGRADE

AVAILABLE IN LARGE SHEETS OR PIECES STAMPED TO YOUR DIMENSIONS.

CLASS C INSULATION

COMMUTATOR MICA INSULATION

Molding Plate — Segment Plate — Mica Rings — Mica Segments — Mica Bushings
Class B and Class H
For all types of starting and generating motors
Accurate to specified dimensions
Properties controlled to assure fullest efficiency of assembly and operation of commutators

FLEXIBLE MICA & COMPOSITES

Class B and Class H
Sheet, roll and tape forms
Formed slot liners

COIL & SLOT INSULATION

Molded or formed to specified dimensions

MICA TUBING

Round, square, rectangular
Class B and Class H

Tell us your area of interest and we will send generous samples for testing — or, send drawings for quotation and learn how you can have better insulation at lower cost.

NEW ENGLAND Mica CO., INC.
WALTHAM 54, MASSACHUSETTS

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IF YOU REQUIRE
SOMETHING SPECIAL

DON'T
SUBSTITUTE

CHECK
CAROLINA
FOR

"KESTER"
ELECTRICAL INSULATING
MATERIALS

SPECIALTY INSULATING FABRICS
OF GLASS, WIRE, "DACRON" AND
OTHER SYNTHETICS

FIBER GLASS WOVEN TAPES

COTTON TAPES AND WEBBINGS
natural-dyed-purified

COLORED INSULATING YARNS
soft or glaze finish

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Print Ins. 33 on Reader Service Card

phenolic molding compound for electrical switchgear and control parts combines an impact strength of 2.5 average (ft lbs/in of notch) with a compressive strength of 12,000 psi, a tensile strength of 6,000 psi, and a compressive strength of 22,000 psi, (all average values). Affording a low bulk factor for this class of material, the reinforced phenolic—designated RX 495—molds to a high luster finish with a mold shrink of only .001"/inch. Other important properties reported are: average arc resistance of 165 seconds and average ignition time (flame resistance) of 340 seconds. Rogers Corp., Rogers, Conn.

Print No. Ins. 115 on Reader Service Card

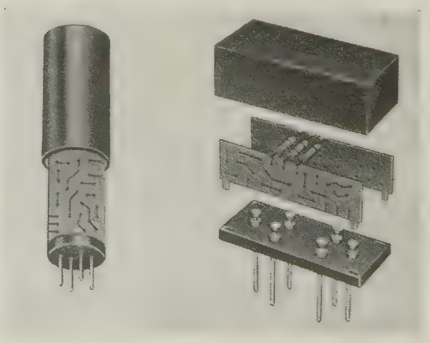
Insulating Spray for Electrical Equipment, Parts, and Wiring

"Insl-x" E-26 dielectric material for insulating electrical equipment, parts, and wiring is now available in aerosol dispensers for quick and easy spray coating. A coating one mil thick reportedly can be sprayed in one application and dried in from three to five minutes. Dielectric strength of 800 to 1200 vpm is claimed for the material which is available in clear, aluminum, and black. Insl-X Co. Inc., Ossining, N.Y.

Print No. Ins. 116 on Reader Service Card

Miniature Custom Molded Epoxy Printed Circuit Boards

Epoxy molding compounds are used to manufacture a new type of miniature molded printed circuit board. High temperature resistance, high dielectric characteristics, low moisture absorption, high dimensional stability, good mechanical strength, and excellent chemical resistance are claimed. Circuits are of high conductivity silver. Gold-plated circuitry is available for added tarnish and corrosion protection. Shapes other than flat boards, such as oval, concave, convex, and the like made to conform to a particular space or assembly, are possible with this molding technique. Also, circuits may be molded in standard potting shells or cases, making the board an integral part of the module package. For circuit packaging, epoxy shells and headers with terminal styles and layouts to specification are available to provide a complete module encapsulation system. Plastronic Engineering Co., 721 Boston Post Rd., Marlborough, Mass.



Print No. Ins. 117 on Reader Service Card

Dimensionally Stable Insulating Rod for Electrical Applications

A new insulating material, known as Spaulding 800 rod, is said to maintain unusually high dimensional stability under conditions of high moisture. Applications include use as insulating pins in the temperature control dials of electric fry pans and other small household appliances which must be washed or come in contact with water frequently. The material is available in bulk form with either a linen or paper base, or fabricated to user dimensions. Its great physical strength reportedly allows machining to close tolerances in a variety of fabricating techniques. Spaulding Fibre Co. Inc., 310 Wheeler St., Tonawanda, N.Y.

Print No. Ins. 118 on Reader Service Card

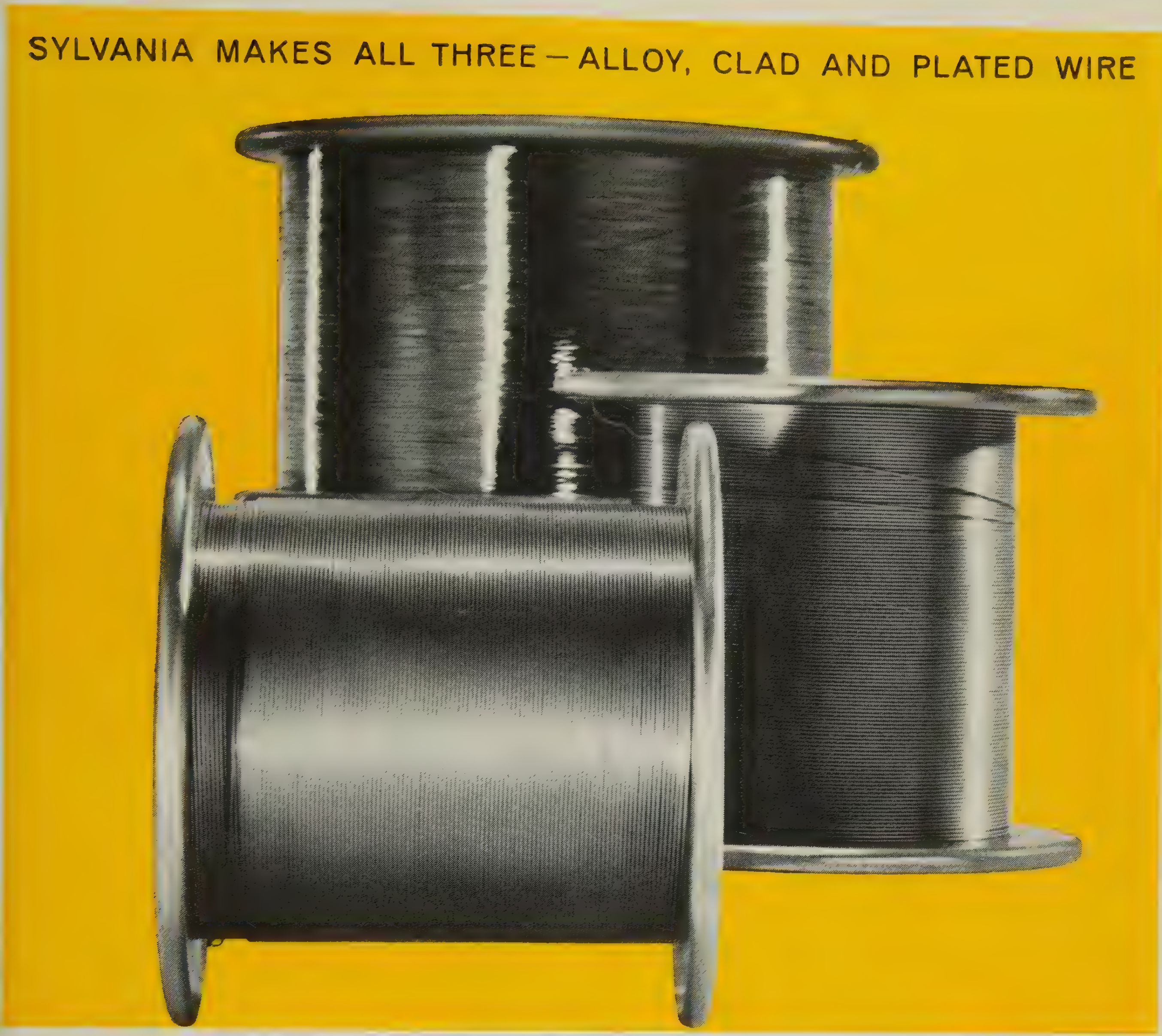
New Glass-Reinforced Polyester Laminate for Electrical Apparatus

New glass-mat-reinforced polyester laminates for use in electrical apparatus are said to resist deterioration by flame, moisture, arcing, leakage currents, and impact. Good physical properties are claimed under temperatures up to 130°C. The material is also reported to exceed NEMA GPO-1 performance requirements for plastic laminates. The new "Micarta" material is available as thick plate, angles, or sheets, and in other shapes by special order. Micarta Div., Westinghouse Electric Corp., Hampton, S.C.

Print No. Ins. 119 on Reader Service Card

Room Temperature Curing Epoxy Casting Resin Is Fire-Retardant

A new fire-retardant epoxy casting resin which may be cured at room



How to speed up design of new products

—call Sylvania for an unprejudiced recommendation on wire

With design time for high-temperature equipment so much at a premium, it pays *not* to get bogged down by noncreative engineering details. Case in point: selecting wire to meet specific conductivity needs in corrosive or oxidizing atmospheres.

You can save valuable time by calling on Sylvania for a wire recommendation. You see, Sylvania knows wire—knows the particular advantages of each kind. And of all major manufacturers, only Sylvania makes all three types of bare wire—alloy, clad and plated. Available in a complete range of sizes—.002 to .250, retains optimum characteristics at temperatures up to 1600° F.

Result? Your Sylvania wire recommendation is unbiased. It's based on *your* design's needs and is not restricted by a limited line. You can get full details for future use—or timesaving help on your present project—by writing Sylvania Electric Products Inc., Parts Division, Warren, Pennsylvania.

SYLVANIA

Subsidiary of

GENERAL TELEPHONE & ELECTRONICS

Print Ins. 34 on Reader Service Card

temperature is said to have excellent adhesion to metals, plastics, and ceramics. A low thermal coefficient of expansion and high heat stability reportedly permit large embedments to be made. It is stable over a temperature range of —100 to +350°F. "Stycast" 1231 can be color coded to specifications, but normally is supplied in black. Thin sections of cured Stycast 1231 repeatedly introduced to a flame will immediately extinguish it is claimed. Emerson & Cuming Inc., 869 Washington St., Canton, Mass.

Print No. Ins. 120 on Reader Service Card

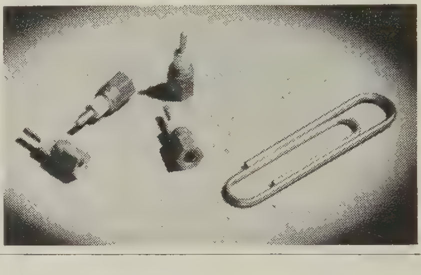
High Performance Urethane Adhesive with Electrical Properties

Polyurethane adhesive #1252 is said to be easy to use and will thermoset at room temperature to produce high peel and tensile shear values between almost any materials. The adhesive reportedly has excellent electrical properties, will give superior performance from —200° to +200°C, and is generally unaffected by solvents, alkalies, and other reagents. Excellent elongation permits adhesion between materials with greatly dissimilar thermal coefficients of expansion. Because of high film strength, it will absorb mechanical and thermal shocks that might disrupt epoxy and other thermosetting adhesive bonded materials. Applied Plastics Co. Inc., 130 Penn St., El Segundo, Calif.

Print No. Ins. 121 on Reader Service Card

"Teflon"-Insulated Threaded Terminals

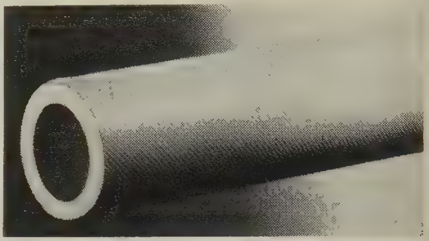
Teflon-insulated threaded terminals for use under conditions of extreme vibration, type TF-300, mount on chassis by means of a screw from the under-side of the chassis. The use of Teflon to insulate the terminal stud from the mounting hardware reportedly permits complete soldering operations without burning, charring, or cracking of the insulation. Sealectro Corp., 610 Fayette Ave., Mamaroneck, N.Y.



Print No. Ins. 122 on Reader Service Card

Envelopes for Wires with Hot Spots

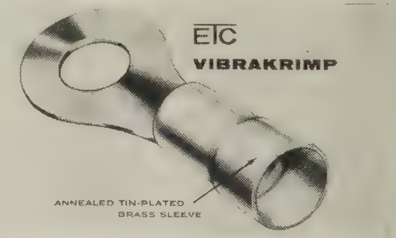
A special insulation envelope of coated "Dacron" for use on wires or cables that are subjected to extreme hot spots zips on in seconds. Envelope is claimed to withstand temperatures up to 300°F for a period of 100 hours or more, 400 to 450°F for 10 minutes. Envelopes come in all sizes and with whatever thickness of insulation is required. The Zippertubing Co., 752 S. San Pedro St., Los Angeles.



Print No. Ins. 123 on Reader Service Card

Terminals Resist High Vibration

Engineered for use where excessive vibration is encountered, a new line of "Vibrakrimp" solderless electrical terminals are given even greater strength by a seamless, annealed, tin-plated brass sleeve permanently attached over the regular terminal barrel. In addition, the "skirt" part of the sleeve extends beyond the barrel and is crimped in the same operation as the barrel to permanently grip the wire insulation, preventing creep. Any wire flexing takes place beyond the terminal, away from the crimping point, eliminating the vibration hazard. The new Vibrakrimp terminals come in all tongue types: ring, hook, spade, flanged spade, and rectangular. ETC Inc., 990 East 67th St., Cleveland 3, Ohio.



Print No. Ins. 124 on Reader Service Card

ROBBINS & MYERS, Inc.

uses PERMA-FORM®

MACHINE FORMABLE INSULATION

for STATOR ASSEMBLIES...

- "To permit forming coils to closer tolerances."
- "To reduce rejects due to damage in forming."
- "To help anchor field leads to field coil."
- "To increase production -- quick installation reduces labor costs."

Designed primarily as coil-retainer stock, PERMA-FORM is a combination of Mylar® rag laminate and flat rolled wire.

Dielectric strengths:

- .005" rag paper and .002" Mylar. 1400 volts per mil.
- Adhesive (approx. 1 mil used) -- 500 volts per mil.

Further specifications and information on special combinations of lamination available on request.

WRITE FOR FREE 10 FT. SAMPLE TO:

W. J. RUSCOE COMPANY LAMINATING DIVISION
475-485 Kenmore Blvd. Akron 1, Ohio
2127

Print Ins. 35 on Reader Service Card

Magnet wires can feature both reliability and soldering ease. FORMVAR (polyvinyl formal) resins, noted for dependability over the past 20 years, can be used in combination with isocyanate-polyester* mixtures to give high quality solderable enamels. In use for almost 3 years, three component enamels of this type have improved flow properties, flexibility and resistance to heat shock and solvents. Coated wire will tin in 5-10 seconds at 350°C.

*Such as Mobay Chemical Co., "Mondur S"-"Multron"

For wire insulations which permit trouble-free service, lower production costs, and greater efficiency, look to enamels based on FORMVAR. Shawinigan's exacting production controls and applications research keep FORMVAR a dependable ingredient for magnet wire enamels. Shawinigan Resins Corporation, Dept. 5206, Springfield 1, Mass.

SALES OFFICES: ATLANTA CHICAGO LOS ANGELES
NEW YORK SAN FRANCISCO SPRINGFIELD

FORMVAR® polyvinyl formal by

SHAWINIGAN RESINS

Print Ins. 36 on Reader Service Card

CHEMPRO TEFLON*
"INSULATION" GRADE
STOCK
ONLY HIGHEST QUALITY
ELECTRICAL GRADE POLYMER USED

You get better, longer lasting parts from Chempro Teflon "Insulation" Grade Stock. It is made from electrical grade TF-5 polymer. This pure, high quality material assures you a denser, more uniform Teflon for greater service life.

Chempro "Insulation" Grade Teflon is being used as connectors, inserts, spacers, wrappings in connection with standard and special high voltage, high frequency and high temperature electronic, electrical and military equipment.

Prices and deliveries quoted promptly. Write for Bulletin CP-554.

TAPE

Pressure-Sensitive Tape — Used as a Class H insulating tape. Available 0.0035", 0.006" and 0.013" thick, in standard widths from 1/2" to 2" in 18-yard and 36-yard rolls. A special 12" wide tape is now available by the linear yard.

Standard and Cementable Tapes — .002" to .005" thick in widths from 1/4" to 24"; .006" to .096" thick in widths from 1/2" to 24".

TEFLON SHEETS

Standard sizes are
24"x24" and 48"x48"

THICKNESS (inches)	WEIGHT (lbs./sq. ft.)	THICKNESS (inches)	WEIGHT (lbs./sq. ft.)
1/16	0.75	1/2	6.00
1/8	1.5	3/4	9.00
3/16	2.25	1	12.00
1/4	3.00		

RODS

EXTRUDED — 1/4" to 2" diameter in increments of 1/16", in lengths up to 12'.

MOLDED — 1 1/8" to 2" diameter lengths up to 12", in increments of 1/8"; 2" O.D. and over in increments of 1/4" in lengths from 6" to 12".

MOLDED CYLINDERS

2" O.D. and up with minimum wall thickness of 1/2" in increments of 1/4". Maximum length is 12".

*duPont trademark

CHEMICAL & POWER
PRODUCTS, Inc.

11 Broadway, New York 4, N. Y.

Print Ins. 37 on Reader Service Card

Ceramic-"Teflon" Insulated Resistance Wire

New resistance alloy wire has a dual layer, high-temperature insulation of ceramic and Teflon (TFE) fluorocarbon called "Ceron." The insulated resistance wire reportedly is capable of operating continuously at temperatures of 250°C, and up to 300°C for short periods. The combination of a ceramic undercoating with an overlay of Teflon is said to impart better mechanical and electrical properties than a ceramic or a (TFE) fluorocarbon coating alone and to offer excellent solvent and heat resistance. The ceramic underlay is claimed to enable Ceron to resist thermoplastic flow better than a coating of pure (TFE) fluorocarbon. Ceron insulation is available on "Kanthal" DR, an iron-based alloy with a high resistivity of 812 ohms per circular mil foot, as well as on several Nikrothal alloys. Gauges from 0.001" to 0.0045" wire diameters are currently available, with heavier gauges on special order. The Kanthal Corp., Amelia Place, Stamford, Conn.

Print No. Ins. 125 on Reader Service Card

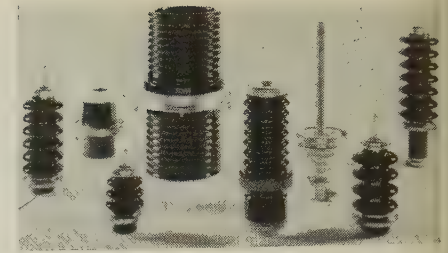
New Mold Release for Epoxy Resins and Silicone Rubbers

New fluorocarbon Telomer mold release for epoxy resins, silicone rubbers, etc., is available in a handy 16-oz aerosol can. The material is applied by spraying and buffing with a soft cloth. No drying time or baking is required. Miller-Stephenson Chemical Co. Inc., 39 Day St., S. Norwalk, Conn.

Print No. Ins. 126 on Reader Service Card

Solder-Seal Bushings for Low Voltages

Solder-seal bushings designed for low voltage applications on hermetically sealed capacitors, test transformers, and similar types of electrical equipment are said to be completely leak-proof, with high mechanical and dielectric strength, and can be designed in a choice of shapes, sizes, and ratings to fit a wide range of applications. The bushings consist of a porcelain unit with a thin "fired-on" metal coating to which metal caps, flanges, rings, etc., can be attached by soft solder techniques. The completed attachment reportedly is strong and permanent and will rupture the glaze from the porcelain before it will rip the metallized band from the glaze. Lapp Insulator Co. Inc., Le Roy, N.Y.



Print No. Ins. 127 on Reader Service Card

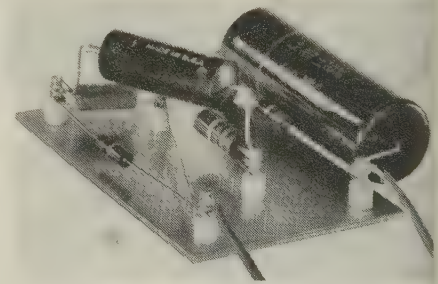
Copper Coating for Smooth Plated Thru-Holes in Printed Circuits

An electrically conductive copper coating, "Conduct-a-Coat," is said to be a new, simple, positive, and economical way to plate thru-holes in printed circuits. The material is applied by dipping, removing excess, oven-drying, light sanding, and copper strike. This process reportedly fills and levels irregularities—contributing to a smoother, precision-plated hole. Expensive equipment or laboratory controls are not needed. Six-oz sample kits are available at $5.95 each. Etchomatic Inc., 182 Newton St., Waltham, Mass.

Print No. Ins. 128 on Reader Service Card

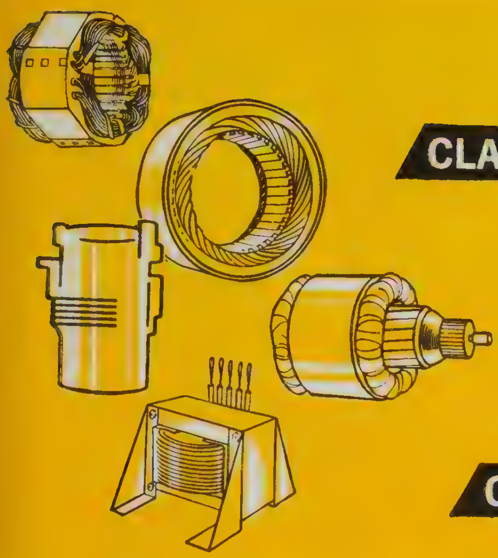
Rugged "Teflon" Terminal with Three Termination Positions

A new triple-turret terminal, type St-1150, is designed to fill the need for rugged terminations in multi-layer, or extremely complex circuitry requiring common terminations of three or more conductors at a single point.



A new mechanical design is said to provide extra rigidity to resist high torque pulling under both assembly and operational conditions. Each of the three termination positions has a holding collar for extra strength in termination. ST-1150 also offers a voltage breakdown factor of 9000 v flashover at sea level. Sealectro Corp., 610 Fayette Ave., Mamaroneck, N.Y.

Print No. Ins. 129 on Reader Service Card



Where can these 5 top performers help YOU improve results . . . *cut costs?*

CLASS H 180°C.

MODIFIED-SILICONE VARNISH V61 V 25
(formerly V61 V C51)

- High heat resistance PLUS high chemical and moisture resistance — meets most Class H requirements
- Air dry or bake
- High build for secure bonding

CLASS F 155°C.

AJAX INSULATING VARNISH V61 V 30
(solvent type)

- Exceeds Class F requirements — withstands intermittent 180°-200°C. temperatures
- Retains high bond strength
- Gives high moisture and chemical protection

AJAX INSULATING VARNISH V61 V 29
(emulsion type)

- Nonflammable — uses WATER as thinner
- Deep penetration — high build
- Excellent resistance to oils, solvents, chemicals, moisture

CLASS B 130°C.

CLEAR, SYNTHETIC THERMOSETTING VARNISH V61 V 24
(formerly V61 V C72)

- Heavy-duty, low cost — meets appliance motor needs
- Outstanding bonding strength
- Fast baking — high build

AJAX EMULSION THERMOSETTING VARNISH V61 V 28
(formerly V61 V C69)

- Saves solvent costs — thins with water
- Deeper penetration — higher build — than solvent materials
- Excellent resistance to oils, solvents, chemicals, moisture

Are new, compact, equipment designs creating new thermal problems for your insulating varnishes? Do you know the benefits that emulsion-type varnishes offer in higher build and bond strength? Are you getting all the advantages of recent improvements in insulating-varnish performance?

You'll find new and better solutions to many insulating problems in the complete line of Sherwin-Williams Insulating Materials. They provide a full range of choice in thermal rating, in physical and electrical properties, in types of solvents and in curing schedules. Ask for technical data on the representative varnishes listed here, or others to meet your specific needs. The Sherwin-Williams Co., General Industrial Division, Cleveland 1, Ohio. In Canada: 2875 Centre St., Montreal.

SWP COVER THE EARTH ®

SHERWIN-WILLIAMS
INSULATING MATERIALS

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Please send data on materials indicated.

☐ Class H Varnish V61 V 25
☐ Class F Varnish V61 V 30
☐ Class F Varnish V61 V 29
☐ Class B Varnish V61 V 24
☐ Class B Varnish V61 V 28

Name ____________________

Company ____________________

Address ____________________

- a wide range of standard sizes
- colored tubing and special sizes
- a wide range of wall thicknesses
- prompt deliveries of

SPAGHETTI TUBING
MADE FROM
TEFLON*
by Pennsylvania Fluorocarbon

To obtain outstanding results from sheathing for wires, slip-on insulation and bushings, use the unique electrical properties of spaghetti tubing made from Teflon plus the outstanding engineering and manufacturing techniques developed by Pennsylvania Fluorocarbon.

The unique electrical properties of spaghetti tubing made from Teflon include: good dielectric strength (1000-2000 volts/mil); lowest dielectric constant (2.0) and dissipation factor (0.0002) of any solid dielectric; no change of electrical properties with temperature (-25°C. to +250°C.), or frequency (60 cycles to 100 mc.); unaffected by moisture. In addition, PF Teflon is not harmed by the hot soldering iron so assembly work is speeded up considerably.

The outstanding engineering and manufacturing techniques developed by Pennsylvania Fluorocarbon include: the tailoring of Teflon with colors for identification or with modifications for improved texture and mechanical properties; stress relieving spaghetti tubing for minimum shrinkage; cleaning and 100% inspection; the manufacture of a wide range of wall thicknesses and special sizes.

Write, wire or call and let us quote on your requirements. We can provide overnight delivery of standard sizes and many special sizes at competitive prices.

PENNSYLVANIA
FLUOROCARBON CO., INC.
1115 N. 38th Street, Phila. 4, Pa.
EVergreen 6-0603 TWX: PH 252

*DuPont registered trademark

Print Ins. 39 on Reader Service Card

Better Anodizing of Aluminum Strip For Electrical Windings

Continuous anodizing of aluminum foil and strip by the "Tyne" chemical process is claimed to result in an aluminum oxide insulating film which is extremely abrasion-resistant and flexible—with no limit to the radius over which the conductor can be bent. The new process is expected to enable manufacturers to make smaller, lighter, better, safer, and cheaper coil windings. United Mineral & Chemical Corp., 16 Hudson St., New York 13.

Print No. Ins. 130 on Reader Service Card

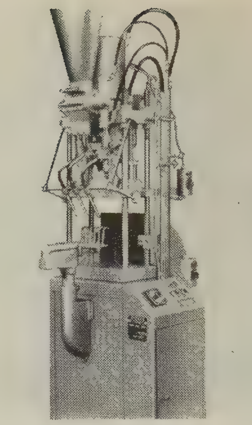
Insulated Cables for Military Uses

A number of new military-type cables are designed for use aboard naval vessels, for army weapons, and for missile systems. "Turbo" 2843 cable is now offered in all cable sizes of specification MIL-C-2194D with a class E dielectric in type MSCA. In types SSGA TSGA, DSGA, and FSGA, cables are available in sizes No. 9 and smaller. Turbo 2843 cable types use natural color silicone rubber and black nylon. Circuit identification is achieved by printing on the nylon in white ink. A manufacturer's identification tape is laid under the vinyl jacket. A line of type 030945 and 21055 cables conforming to specification MIL-C-13777B, type F dielectric, have polyethylene primaries jacketed with either extruded nylon or overbraids in place of the rubber primaries formerly required. A tough neoprene jacket reportedly permits continuous flexibility over an ambient temperature range of —65°F to 165°F, while providing maximum durability from the wearing effects of frequent reeling and unreeling. Fifty-eight individual cable types are offered under specification MIL-C-13777B. These cables are available in clear nylon jacket, or color-coded overbraid in place of nylon. William Brand-Rex Div., American Enka Corp., 100 Valley St., Willimantic 1, Conn.

Print No. Ins. 131 on Reader Service Card

Small Automatic Transfer Press For Molding Electronic Components

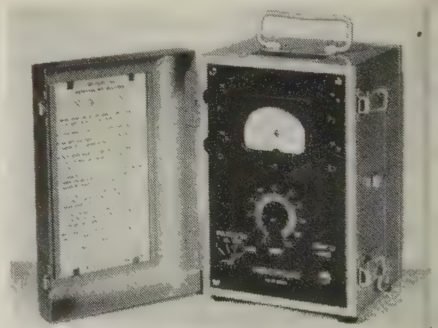
New 25-ton automatic transfer molding press, Model 725, was developed for use on short production runs where low mold costs and quick set-ups are desired. The press can be easily converted from transfer to compression molding; its small size is said to make the unit economical for molding small parts, such as electronic components, in small molds on an automatic basis. Maximum mold size is 11″ by 6″. Many outstanding features are claimed. Plastics Molding Equipment Div., F. J. Stokes Corp., 5500 Tabor Rd., Philadelphia 20.



Print No. Ins. 132 on Reader Service Card

New Portable Instruments Measure Resistance of Electrical Grounds

A new series of instruments for measuring the resistance of electrical grounds in electronic, telephone, and electric power circuits embody numerous design improvements. This new "Vibroground" series includes three models, all of which provide direct reading of ohms resistance to an earth ground. The lightweight, self-contained, battery–operated vibrator power supplies reportedly have improved portability and dependability. Hand cranking and leveling adjustments are eliminated. Direct reading ranges as low as 0-3 ohms, and up to 0-3000 are provided. Bulletin 1-2 available. Associated Research Inc., 3777 W. Belmont Ave., Chicago 18.



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REPORT FROM

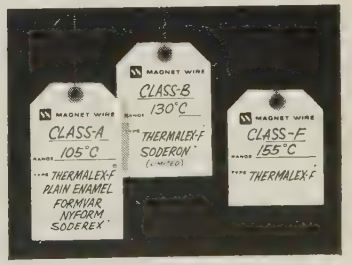
ESSEX MAGNET WIRE LABORATORIES*

*TECHNICAL INFORMATION CENTERS FOR RESEARCH, DEVELOPMENT, VALUE ANALYSIS AND ENGINEERING.

NOW AVAILABLE

Comprehensive Data on Magnet Wire Encapsulation

A series of thermal aging tests were run by Essex Magnet Wire Laboratories to determine the compatibility of a number of magnet wires with encapsulating compounds. This data has been compiled into a test report which can be used as a guide in wire selection. Write for the complete test report or consult your Essex Magnet Wire salesman about the Essex Continuing Magnet Wire Testing Programs.

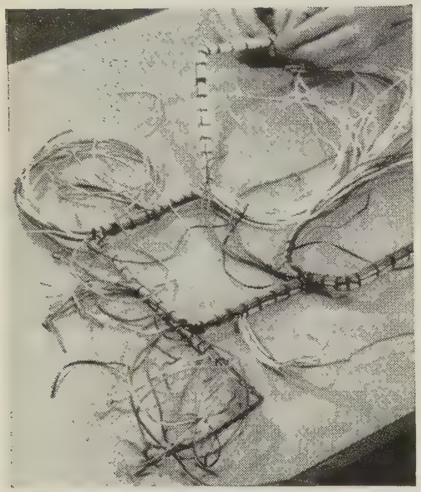


The right insulation for every application with Essex Magnet Wire

MAGNET WIRE DIVISION ESSEX WIRE CORPORATION, Fort Wayne, Indiana

Manufacturing Plants: Anaheim, Calif.; Fort Wayne, Ind.; and Hillsdale, Michigan
National Network of Warehouses and Sales Offices . . . Call Your Local "Essex Man"
Print Ins. 40 on Reader Service Card

GUDELACE
is engineered
for
problem-free
lacing



It's no accident that Gudelace is the best lacing tape you can buy. Excellence is *engineered* into Gudelace. A sturdy nylon mesh is meticulously combined with the optimum amount of special microcrystalline wax. Careful selection of raw materials and superior methods of combining them give Gudelace outstanding strength, toughness, and stability. Gudelace is the original *flat* lacing tape which distributes stress evenly over a wide area. It is engineered to stay flat; it will not stretch out of shape when pulled. Gudelace's nonskid surface prevents slipping, eliminating the too-tight pull that causes strangulation and cold flow. Durability and dependability make Gudelace your most economic buy—with no cut insulation, fingers, or feelings.

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Executive Offices
12 South 12th Street, Philadelphia 7, Pa.

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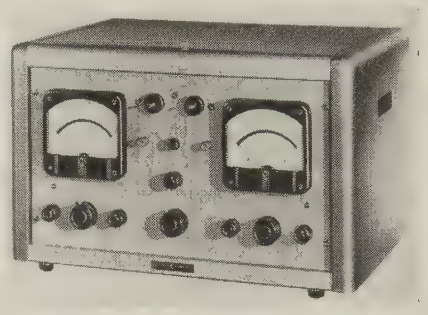
Megatrometers for Ultra High Resistance Measurements

The direct reading model 710H megatrometer provides ultra high resistance measurement to 5 x 10^{16} ohms for measuring insulation resistance in ceramics and insulating materials, and for measuring ion migration and capacitor leakage. With accessories it can be used to measure the volume resistivity of epoxies at normal and elevated temperatures. Resistance range is 140K ohms to 5 x 10^{16} ohms with an upper half-scale accuracy of 3.0% reported. The test potential range is 0 to 1,000 v, continuously variable. A front panel control and built-in circuitry permit stabilization of low-leakage capacitors in seconds to facilitate production testing. The megatrometer is claimed to be completely safe under all operating conditions and cannot be damaged by short circuits or severe mechanical shock. Weight is 40 lbs. Price is $1,495. Mid-Eastern Electronics Inc., 32 Commerce St., Springfield, N.J.



Print No. Ins. 134 on Reader Service Card

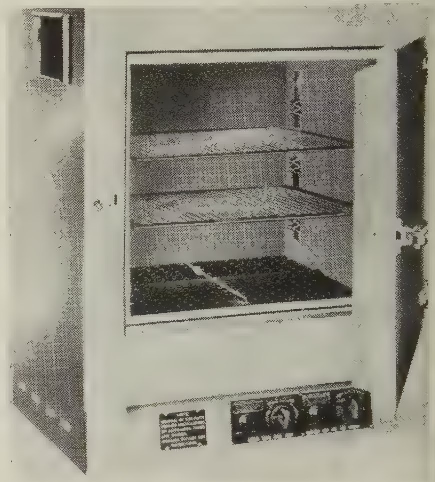
New 120 KV-5 MA D-C Power Supply For Insulation Testing

A new d-c power supply rated 5 ma at 120 kv is said to be ideal for insulation testing, industrial, experimental, and research applications. Known as Model PSC 120-5-2, it is designed to operate on a standard 115 v 60 cycle line. The unit is completely mobile and either positive or negative polarity may be obtained by changing simple plug-in internal connections. Its ripple is less than 2% RMS. The high voltage output is delivered through a shielded polyethylene cable. The two-tone grey steel cabinet measures 32″ x 21½″ x 59″ high. Instrumentation consists of 4½″ 3-range kv and ma meters mounted on an illuminated front panel. Safety features include no exposed high voltage components (oil insulation), external interlocks, automatic stored energy discharge switch, and push button high voltage "on-off" controls. Del Electronics Corp., 521 Homestead Ave., Mount Vernon, N. Y.

Print No. Ins. 135 on Reader Service Card

Utility Oven for Baking, Drying, and Preheating

Mechanically recirculating utility oven for baking, drying, conditioning, preheating, and other utility jobs in the electronic industry has a temperature range of 37.8°C to 260°C. Features claimed include vibrationless vertical airflow and an automatic hydraulic thermostat with a response sensitivity of ±½°C. Controls, pilot lights, and switches are mounted on a removable aluminum wiring panel. Blue M Electric Co., 138th & Chatham St., Blue Island, Ill.



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Microhm-Reading Bridge Uses Leads up to 100 Feet Long

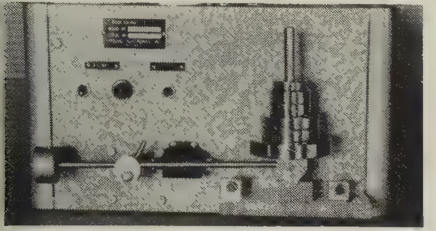
Lead length, often a critical factor in low resistance measurements, is said to have no effect on the measurement accuracy of a new Kelvin bridge. The model 633 instrument measures 10 microhms to 100 ohms. Test leads up to 100 ft. and more reportedly may be employed while maintaining an accuracy of ±0.25% above 100 microhms and ± 1 microhm below 100 microhms. The new bridge is stated to offer an economical means of accurately making low resistance measurements under very difficult testing conditions. Test leads to any length can be furnished with either "C" clamp or spring clamp terminations. Price is $390. Bulletin L54 available.

Shallcross Manufacturing Co., Selma, N.C.

Print No. Ins. 137 on Reader Service Card

Abrasion-Scrape Tester for Film-Insulated Magnet Wire

The model TS-2 tester for determining the abrasion resistance of film-insulated magnet wire repeatedly scrapes the wire with the cylindrical surface of a #11 steel needle. It reportedly conforms to MIL-W-19583 (Navy) requirements. The length of the scrape motion in one direction is 3/8″. Scrape frequency is 60 strokes per minute. The electrical circuit is designed so that failure is detected and the device shut off when the film is worn through to the copper for approximately 1/3 of the stroke length. A mechanical counter indicates the number of strokes required to abrade the wire sample. Input is standard 115 v, 60 cycle, single phase. The metal cabinet measures 14″ x 8″ x 10½″. Peschel Electronics Inc., Towners, Patterson, N.Y.



Print No. Ins. 138 on Reader Service Card

Portable Multi-Conductor Cable Tester

A new, portable, multi-conductor cable tester is a bench-top unit which reportedly will check out a cable of up to 96 conductors for both hi-pot and continuity with a minimum of time and effort. Made in two separable halves, this device can be used for the testing of in-place cables when both ends of the cable are accessible. Three hi-pot test voltages are available: 500, 1000, and 1500 v d-c, with minimum insulation resistance settings of 1, 2, 3, 4, and 5 meg. Provision has also been made for setting in an outside megger. The automatic readout unit contains a 96-light indicator panel to give an instantaneous indication of continuity. The unit will also indicate crossed wires. 115 v, 60 cycle operation is standard. Cable adapter units are available or can be built by the user. Literature available. Leemath Inc., Oak Drive, Syosset, N.Y.

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Association News

NISA Organizes New Chapter

A regional trade association of electrical apparatus service and sales companies in Pittsburgh, western Pennsylvania, and parts of West Virginia and Ohio has been organized by the National Industrial Service Association Inc. William H. Braunlich Sr., Braunlich-Roessle Electric Repairs Inc., Pittsburgh, is temporary chairman.

The new organization, the fortieth chapter of NISA, will be known as the Tri-State Chapter.

Charter members include: Braunlich-Roessle Electric Repairs Inc., and Pennsylvania Electric Coil Co., Pittsburgh; Dumbaugh Electric Repair Shop, Butler, Pa; Flood City Brass & Electric Co., Johnstown, Pa.; Warwood Armature Repair, Wheeling W. Va; and Tri-State Electric and Machine Co. Inc., Moundsville, W. Va.

Annual Appliance Conference, May 16-17

The 11th Annual Appliance Conference sponsored by the committee on Domestic Appliances of the American Institute of Electrical Engineers will be held May 16-17, at the Mansfield-Leland Hotel, Mansfield, Ohio.

The keynote speaker will be R. E. Brooker, president of Whirlpool Corp. The conference will cover such subjects as electrical connections and contacts, the integration of motors into an appliance design, and the philosophy of reliability, quality, and service of appliances.

R. A. Risser, Ohio Brass Co., Mansfield, Ohio, is chairman of the registration committee.

Eight Nominated AIEE Vice Presidents

Those nominated to be vice presidents at the Winter General Meeting of the American Institute of Electrical Engineers were: Clair E. Gaylord, New York Telephone Co., Buffalo, N. Y.; Robert T. Weil Jr., Manhattan College, New York; Fred W. Bush, Allis-Chalmers Manufacturing Co., Milwaukee, Wisc.; Sim C. Wright, Southwest Bell Telephone Co., Oklahoma City, Okla.; Henry A. Carlberg, General Electric Co., Richland, Wash.; Adolph W. Rauth, Consumers Power Co., Jackson, Mich.; Walter Criley, Vanderbilt University, Nashville, Tenn.; and Paul G. Wallace, Texas Power & Light Co., Dallas, Tex.

Six New Members Join NEMA

Six more companies have joined the National Electrical Manufacturers Association. They are: DeJur Amsco Corp., Long Island City, N.Y.; Markel Electric Products Inc., Buffalo, N. Y.; Assembly Products Inc., Chesterland, Ohio; Union Carbide Consumer Products Co., Division of Union Carbide Corp., New York, N. Y.; Electromode Division of Commercial Controls Corp., Rochester, N. Y.; and Specialties Inc., Syosset, L. I., N. Y.

Mica Industry Association Retains Dr. Rustum Roy as Technical Consultant

A new technical information service has been made available by the Mica Industry Association, Inc. The association has retained as a technical consultant Dr. Rustum Roy, who is said to be one of the best informed men in the country on the subject of mica, its properties, and its applications. Those with questions about the properties of mica or its use in specific applications are urged to write to the association office at 420 Lexington Ave., New York 17. The questions the members can't answer will be turned over to Dr. Roy. Dr. Roy, Professor of Geochemistry at The Pennsylvania State University since 1950, is a native of India and has devoted considerable time both in this country and India to the study of mica. He received his B.Sc. and M.Sc. in India and his Ph.D. in Ceramics at Pennsylvania State University.

Name WESCON Working Officials

Electronics industry executives who will guide preparations for the 1960 Western Electronic Show and Convention (WESCON) as chairmen of 14 working committees have been named.

WESCON, scheduled August 23 through 26 in Los Angeles' new Sports Arena, is jointly sponsored by the Western Electronic Manufacturers Association and the Los Angeles and San Francisco sections representing the Seventh Region of the Institute of Radio Engineers. An estimated 35,000 persons will attend the four-day trade show and technical convention. Applications for exhibit space have been sent to about 4000 electronics firms.

Committee chairmen and vice chairmen, and their areas of responsibility are: *All-Industry Luncheon:* Edward C. Bertolet (Behlman Engineering) and E. H. Lockhart (Radiatronics). *Cocktail Party:* William J. Miller (Burton Manufacturing) and Robert L. Boniface (Neely Enterprises). *Distributor Conference:* W. Bert Knight (W. Bert Knight Co.) and R. V. Weatherford (R. V. Weatherford Co.). *Exhibits:* Ernest Clover (Triad Transformer) and Herb Becker (Herb Becker Co.). *Facilities:* Donald N. Montgomery (Aeronutronic) and Duane Wood (Lockheed Aircraft Service). *Field Trips:* A. N. Curtiss (RCA) and Eugene M. Knight (Space Technology Labs.). *Future Engineers:* Joel H. Axe (Ramo-Wooldridge) and Col. Frank J. Shannon Sr., USAF (Ret.) (Packard Bell). *Hospitality:* Burgess Dempster (Electronic Engineering) and John J. Guarrera (Burton Manufacturing). *Industrial Design:* Kenneth J. Slee (Librascope) and Robert C. Saunders Jr., (Benson-Lehner). *Public Relations:* Willard B. Gregory (Beckman Instruments) and Richard L. Paullus (Electronics Investment Management Corp.). *Registration:* G. Goldenstern (Hoffman Electronics) and Harry J. Delaney (Hughes Aircraft). *Technical Program:* Richard G. Leitner (System Development Corp.) and Harper Q. North (Pacific Semiconductors). *Visitors Services:* Al J. Rissi and C. T. "Cap" Kierulff (Kierulff Electronics). *Women's Activities:* Mrs. Jeff Montgomery and Mrs. Don Larson.

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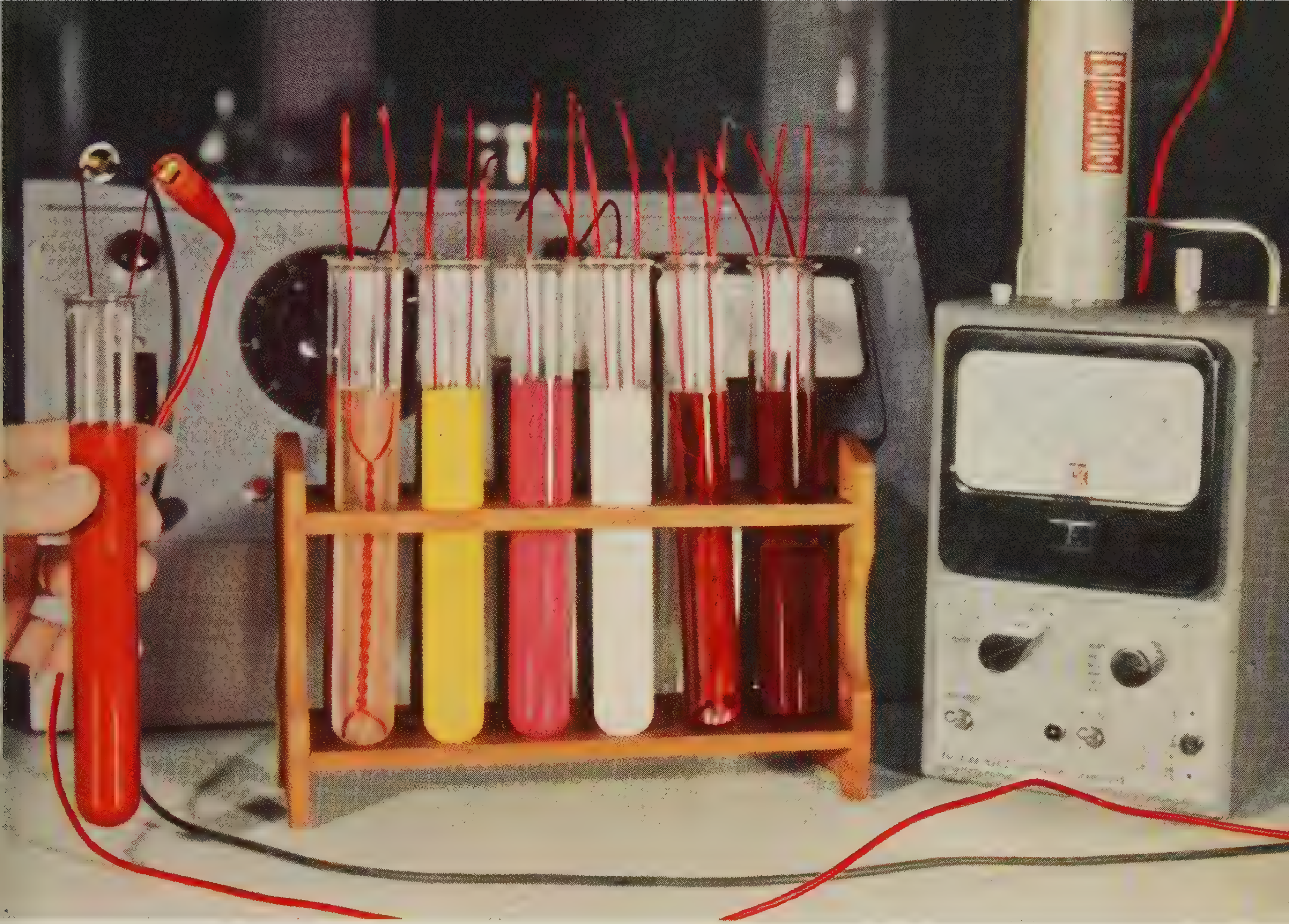

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You can see how Epoxy offers many interesting possibilities for cutting costs and simplifying production through standardization in many totally enclosed as well as open applications.

Our technical staff and our Research and Development Laboratory facilities are available to give you assistance in your compatibility and other magnet wire problems. See the man from Anaconda. Or write: Anaconda Wire & Cable Company, 25 Broadway, New York 4, N. Y. 60251

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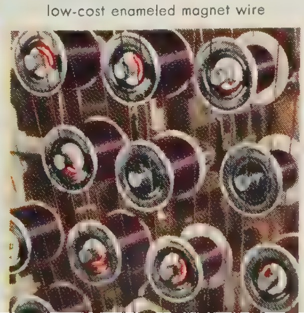

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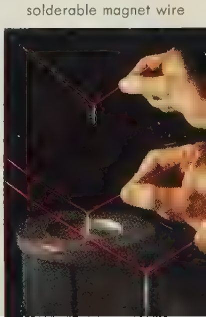

New Publications

Plastics Engineering Handbook of the Society of the Plastics Industry Inc. New third edition contains over 600 pages in larger 7″ x 10″ format; over 500 illustrations, tables, and charts. $15. Reinhold Publishing Corp., Dept. 201, 430 Park Ave., New York 22.

Motor Selection and Application, by Charles C. Libby. Explains motor selection in terms of load characteristics, service requirements, space limitations, duty cycle requirements, and safety. 486 pages, 6″ x 9″, 222 illustrations, and 70 tables. $13.50. McGraw-Hill Book Co., 330 W. 42nd St., New York 36.

Technical Survey. A weekly report on advances in technology. The information is selected from technical periodicals and other publications. Survey covers 18 technical subjects. One year subscription is $35. Reports on one subject, such as "Electrical Developments," may be obtained for $10 per year plus postage. Technical Survey, 650 Newark Ave., Elizabeth, N.J.

Financial Aspects of Producing and Buying Printed Circuits. The proceedings of the 1959 symposium of the Institute of Printed Circuits. $5. Institute of Printed Circuits, 27 E. Monroe St., Chicago 3.

NBS Publications

The following publications may be ordered from the Superintendent of Documents, U. S. Government Printing Office, Washington 25, D.C.

Research Highlights of the National Bureau of Standards. Annual report describes and illustrates the most important developments in the research program of the Bureau during 1959. 169 pages, 55 cents.

Specification for Dry Cells and Batteries, NBS Handbook 71, seventh edition. 20 pages.

Basic Theorems in Matrix Theory, by M. Marcus. Applied Mathematics Series 57. 27 pages, 15 cents.

ASTM Standards

Copies, or information regarding availability of copies of the following revisions or tentative revisions of standards may be obtained from the American Society for Testing Materials, 1916 Race St., Philadelphia 3, Pa.

ASTM Standards on Copper and Copper Alloys B-5. 1959 compilation contains 137 standards of which 17 are new, revised, or have had their status changed since the previous edition in 1957. 720 pages, hard cover, 6″ x 9″, $7.50.

D 876—58T, Methods of Testing Nonrigid Vinyl Chloride Polymer Tubing. Revised tentative contains added definitions and significance statements for brittleness, temperature

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and resistance to penetration.

D 116—44, Standard Methods of Testing Electrical Porcelain. Numerous changes have been made to bring the method up to date.

D 149—59, Standard Methods of Test for Dielectric Breakdown Voltage and Dielectric Strength of Electrical Insulation Materials at Commercial Power Frequencies. Contains a new Appendix I and changes in Section 2 which provide a formal definition of dielectric breakdown voltage and restate the definition of dielectric strength in terms of breakdown voltage and thickness.

D 229—58, Standard Methods of Testing Sheet and Plate Materials Used for Electrical Insulation. Sections 27 (c), 29, and 30 have been changed to remove or reduce the problem of flashover when breakdown voltage tests are performed parallel to the flat sides of sheets using tapered-pin electrodes.

D 257—58, Standard Methods of Test for Electrical Resistance of Insulating Materials. General Procedures (Section 4) have been revised to give greater emphasis to the importance of performing tests with specimens in conditioning atmosphere, a new Section 3 on the possible effects of time of electrification and applied voltage has been added. and Appendix I has been revised to bring area corrections up to date.

D 879—58, Standard Specifications on Communication and Signal Lime-Glass Insulators. Various changes clarify the specifications and bring them up to date.

D 1700—59T, Tentative Specification for Low Voltage Insulating Gloves. Covers gloves designated as Class O-Proof Test 5000 v, 3 min, which are intended to be used only on voltages less than 750 v.

D 574—58, Standard Specification for Ozone Resisting Insulation for Wire and Cable. Revisions in Section 3 (b), (c), and (e) bring the specification up to date.

ASESA Revisions

The following are changes or revisions of military specifications announced by the Armed Services Electro-Standards Agency. Printed copies are not yet available.

MIL-E-1/1011B, Electron Tube JAN-5957. Revision B to MIL-E-1/1011A (SigC) revises the Signal Corps limited specification into a coordinated document, deletes the high altitude maximum rating, and incorporates other changes.

MIL-E-1D. Electron Tubes and Crystal Rectifiers, Amendment 3—adds a new paragraph on special marking.

MIL-STD-221A, Color Code for Resistors. Revision A deletes the color coding for composition type radial lead resistors, deletes the ±20% tolerance from the color code (Table 1), references MIL-STD-174 instead of MIL-STD-104 for standard colors, and relaxes the requirement in the conflict of colors paragraph.

MIL-C-17C, Cables, Radio Frequency: Coaxial, Dual Coaxial, Twin Conductor and Twin Lead. Supersedes MIL-C-17B with many significant changes.

MIL-S-61B, Shunts. Instrument, External 50-Millivolt (Lightweight Type). Supersedes MIL-S-61A with

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several changes and additions.

MIL-R-11/9, Resistors, Fixed, Composition (Insulated). This is a new detail specification covering style RC12 resistors.

MIL-E-1/211B, Electron Tube JAN-3C24. Revision B to MIL-E-1/211A (dated 28 June 1958) changes the life test group category from "Group B" to "Group C."

Other Standards Publications

IEC Publication No. 112, Recommended Method for Determining the Comparative Tracking Index of Solid Insulating Materials Under Moist Conditions. $2.40. Order from American Standards Assn., Dept. PR 116, 70 East 45th St., New York 17.

AIEE Index of Standards Publications. Includes both subject and number indexes of standards, test procedures, recommended practices, specifications, or guides issued by the American Institute of Electrical Engineers and some American Standards Assn. standards and test codes. Order from AIEE, 33 West 39th St., New York 18.

EIA Standard RS-230, Color Marking of Thermoplastic Covered Wire. From standards proposals No. 618, 575, and 557, it is a revision of GEN-104. 4 pages, 25¢.

PB 161056, Power Generation and Distribution, Chapter 2—Mobile Emergency Power Plants. 70 pages, $1.75. Order from the Office of Technical Services, Business and Defense Services Administration, U. S. Dept. of Commerce, Washington 25, D.C.

C57.12.20-1959, Overhead-Type Distribution Transformers, 67,000 Volts and Below, 500 KVA and Smaller. $2.20. Order from American Standards Assn., Dept. PR 120, 70 E. 45th St., New York 17.

EIA Standard RS-229, Fixed, Wire-Wound Precision Resistors. 11 pages, $1.10. Order from Electronic Industries Assn., Engineering Dept., 650 Salmon Tower, 11 West 42nd St., New York 36.

They married for better or worse. She couldn't do better and he couldn't do worse. *The Kablegram*

Rocket Pioneer

Robert Hutchings Goddard of Clark University pioneered development of rockets that could be controlled in flight and reach "great heights." In 1936, using a liquid propellant mixture of gasoline and oxygen, Goddard launched a rocket that achieved a speed of 700 mph and a height of 7500 feet.

A-C Surrenders Rights to Oil Tests

Surrender of patent rights to two methods for testing transformer oil developed in its Central Research Laboratories has been announced by Allis-Chalmers. The one method is for estimating interfacial tension of the oil; the other for estimating the neutralization number of an oil. The inventions, which are being applied in Allis-Chalmers kits for quick testing of transformer oil without requiring highly technical personnel and expensive equipment, will be published by ASTM and AIEE in their standard books.

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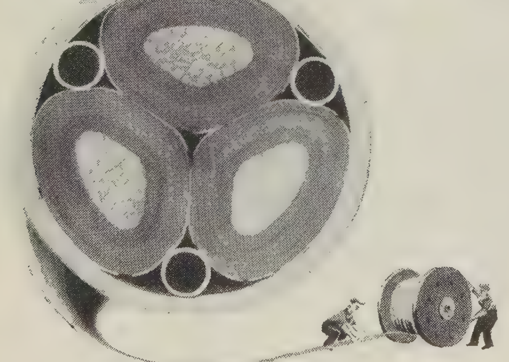

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New Literature

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Complete Bulletin on Polycarbonate Plastic for Electrical and Other Uses

Bulletin No. TIB 41-M1 lists detailed physical and electrical properties of "Merlon" polycarbonate resin, a new thermoplastic expected to be suitable for many electrical applications. Features are described. The bulletin also compares Merlon with seven other plastics, discusses fabrication, and lists applications. Electrical insulation applications mentioned include coil forms, printed circuits, cable wraps, capacitors, mountings, sockets, boards, parts and components, etc. 6 pages. Mobay Products Co., 1815 Washington Rd., Pittsburgh 34, Pa.

Print No. Ins. 201 on Reader Service Card

Silicone Products Guide

A 1960 guide to a complete line of silicone products lists major product uses and benefits of silicones for electrical insulation, antifoam and release agents, coatings, additives, and other applications. Another section of the guide, CDS-129B, is devoted to silicone rubber, including liquid RTV compounds, for electrical and electronic insulation and other applications. Silicone Products Dept., General Electric Co., Waterford, New York.

Print No. Ins. 202 on Reader Service Card

Fabricated Laminates Brochure

A new bulletin on fabricated laminates discusses some of the thousands of applications and uses for fabricated parts—punched, machined, ground, drilled, or turned from "Insurok" sheet, tubes, and rods—in the mechanical, chemical, or electrical fields. It also outlines integrated facilities for manufacturing the laminates. Illustrations show steps in tooling and producing finished parts. 4 pages. The Richardson Co., 2753 Lake St., Melrose Park, Ill.

Print No. Ins. 203 on Reader Service Card

New Epoxy Resins Catalog

New booklet, Data for Industry No. 1, tells how three new epoxy resins for encapsulating electrical and electronic components and for other applications differ from conventional epoxies. Outstanding features, basic technical information, electrical and mechanical properties, formulations, cure systems, exotherms, and high-temperature characteristics are covered in detail. 24 pages. Epoxy Dept., Food Machinery and Chemical Corp., 161 East 42nd St., New York, N.Y.

Print No. Ins. 204 on Reader Service Card

Bulletin on Custom Molded "Teflon" In Thin Sections and Shapes

Bulletin lists electrical and physical properties and other characteristics of Teflon, illustrates typical custom molded parts, and discusses advantages of facilities and patented process for custom molding of Teflon parts in thin sections and shapes. 4 pages. Sparta Manufacturing Co., Division of United States Ceramic Tile Co., Dover, Ohio.

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Polypropylene Technical Manual

A new technical booklet on "Profax" polypropylene contains an up-to-

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When your project requires a high temperature lead wire with excellent electricals, corona resistance, flexibility, oil and weather resistance, and rated for continuous use at 200°C, try Markel FLEXLEAD Silicone Rubber Insulated Lead Wire. Silicone Rubber is precision-extruded over stranded conductors of silver-plated copper wire to make FLEXLEAD SR, newest product in the *Line of Excellence*. Ask for prices and data.

L. FRANK MARKEL & SONS
SINCE 1922
1 SOURCE *for* EXCELLENCE *in*
Insulating Tubings, Sleevings, and Lead Wire
NORRISTOWN, PENNSYLVANIA

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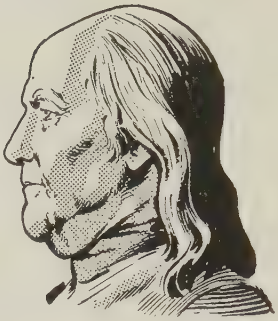
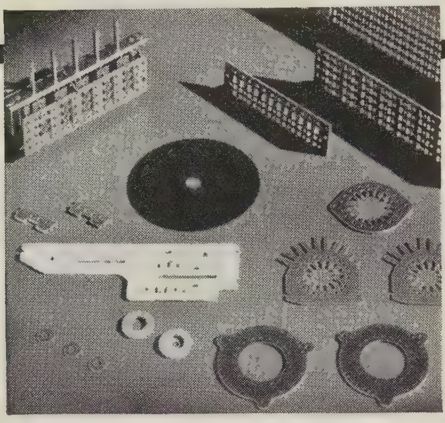
BEN WOULD HAVE LOVED INSUROK®
FOR HIS OWN ELECTRICAL
APPARATUS!

- *Perfect for Fabricated Parts*
- *Superior Electrical Properties*
- *Greater Design Possibilities*
- *Lightweight, Non-Corrosive*





INSUROK is the copyrighted brand name for The Richardson Company's complete family line of laminated plastics.

Richardson INSUROK parts outperform and outlast other materials because of their unique combination of properties. Outstanding INSUROK characteristics are:

- **Low dielectric loss.**
- **Low moisture absorption.**
- **Heat and blister-resistance.**
- **Unmatched insulating qualities.**
- **Remarkable strength and durability.**
- **Good machinability.**

Richardson laminated, machined and fabricated parts are produced in a wide range of characteristics to meet many kinds of electrical and electronic applications. New grades, sizes, and shapes are constantly being developed for new applications.

Whatever your specific product application . . . electrical or mechanical . . . specify and insist on INSUROK. Write for comprehensive details in bulletin form on how you can profit by using INSUROK, or phone today.

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Laminated
Fabricated
and
Molded
Plastics

FOUNDED IN 1858

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date summary of a broad background of technical experience. Information on electrical properties, physical characteristics, mechanical properties, chemical resistance, injection molding, extrusion, and fabrication, is supplemented with tables, charts, and photographs and descriptions of commercial applications. The various types of polypropylene, packaging and shipping data, and a bibliography on polypropylene are included. 24 pages. Cellulose Products Dept., Hercules Powder Co. Inc., Wilmington 99, Del.

Print No. Ins. 206 on Reader Service Card

New Bulletin on Hot-Punch Copper-Clad Laminates

New bulletin describes hot-punch copper-clad laminates said to possess excellent punching and electrical characteristics. Pertinent physical, mechanical, and electrical properties of the paper-base phenolic-resin laminate are cited, together with dimensional data. Results of bond strength, hot solder and oven testing for heat resistance, and insulation resistance tests are shown in bulletin No. 3.1.8.2. 2 pages. Taylor Fibre Co., Norristown, Pa.

Print No. Ins. 207 on Reader Service Card

Data Sheet on Grid Boards for Prototype Printed Circuits

"Fotoceram" printed circuit grid boards for use in making prototype printed circuits are described in new data sheet CE-3.01. Advantages, processing instructions, and material characteristics are covered. 2 pages. Corning Electronic Components, Corning Glass Works, Bradford, Pa.

Print No. Ins. 208 on Reader Service Card

Catalog of Plastic Electronic Insulating Products

New, comprehensive electronic products catalog lists and describes Chemelec "Teflon," nylon, "Kel-F," "Delrin," and other plastic electronic components and insulation products. Bulletin AD-169 outlines specific mechanical and electrical design and environmental characteristics of the products listed. Comprehensive drawings, illustrations, and tables are furnished for such items as metal base stand-off and feed-through insulators, hermetically sealed feed-through insulators, compression mounted and miniature nine-pin tube base connectors, test points, a wide variety of miniature and sub-miniature sockets, copper-clad Teflon for printed circuits, spaghetti tubing, and grommets. 24 pages. Garlock Electronic Products, The Garlock Packing Co., 443 Main St., Palmyra, N.Y.

Print No. Ins. 209 on Reader Service Card

Manual Describes Procedures for Measuring Insulation Resistance

Simplified procedures and step-by-step diagrams for measurement of insulation resistance are incorporated in a new manual of operating instructions and application data for the direct reading "Vibrotest" megohmmeter. Titled "Insulation Resistance Measurements," it describes the unit, tells how to prepare for tests and operate the unit, and covers testing of many specific types of equipment. 32 pages. Associated Research Inc., 3777 West Belmont Ave., Chicago 18.

Print No. Ins. 210 on Reader Service Card

New Insulating Materials Catalog

Catalog GET-2929A describes in text, tables, and illustrations the characteristics and applications of a complete line of insulating materials for electrical equipment. Technical data and suggested uses are provided for mica mat, built-up mica, coated materials, varnishes, paints, adhesives, compounds, thinners, irradiated materials, wire enamels, and permafils. Ordering information included. 12 pages. General Electric Co., Schenectady 5, N.Y.

Print No. Ins. 211 on Reader Service Card

Engineering Bulletins on Two New High-Temperature Laminates

Two engineering bulletins describe new industrial phenolic laminated plastics, grades ARF-HT (asbestos mat) and G3-HT (glass fabric), developed for use to 500°F. Basic physical and electrical information and the sheet properties of each laminate are listed. 2 pages. Synthane Corp., Oaks, Pa.

Print No. Ins. 212 on Reader Service Card

Fabricated Silicone Rubber Bulletin

New bulletin on custom engineered fabricated silicone rubber describes engineered seals for the aircraft, electronic, and appliance industries; precision molded parts; extruded parts; and sheet and die cuts. This manual reportedly enables the engineer to select and specify the correct silicone rubber part to meet typical application problems. Also described are facilities for formulating special purpose compounds to meet specific requirements. 6 pages. Haveg Industries Inc., Taunton Div., 336 Weir St., Taunton. Mass.

Print No. Ins. 213 on Reader Service Card

Meter Selection Catalog

An all-inclusive Meter Master Chart for quickly determining the one meter that combines up to 23 ranges to meet individual measuring needs is among the many highlights of a new meter catalog. The catalog lists and displays current, voltage, and high resistance (megohm) meters available in portable, panel, and bench models for field, laboratory, and production line use. Selective-expansion meters, that expand a small dial section to cover the full scale. and differential meters. that detect and measure differences as fine as one part in 100,000, are also discussed. Prices included. 20 pages. Greibach Instruments Corp., 319 North Ave., New Rochelle, N.Y.

Print No. Ins. 214 on Reader Service Card

Laminated Insulator Case History

Case history describes how the high mechanical strength provided by phenolic-paper laminated plastic insulators permitted economical, high-volume, and automatic assembly of switch parts. The mechanical requirements imposed by fabricating and assembly needs as well as the basic insulating requirements are outlined. A photo and a line drawing show the configuration of the stator and point up the spacing problem. 1 page. Taylor Fibre Co., Norristown, Pa.

Print No. Ins. 215 on Reader Service Card

Brochure on a New Rubber-Like Urethane for Molding or Machining

Brochure on "Daycollan," a new rubber-like material, contains charts showing physical properties, applications, and advantages. The material is a cast, or solid, urethane which can be made into molded or machined finished parts and which is also supplied in sheet stock in a Shore durom-

FLEXITE®

Do your requirements call for an insulating tubing with outstanding flexibility; high tensile strength, elongation, and tear strength; excellent resistance to corona, oils, and the effects of weather; and rated for continuous use at 200°C? Then specify Markel FLEXITE SR Silicone Rubber Extruded Tubing, a recent addition to the Markel *Line of Excellence* in sleevings and tubings. Ask for additional data and test samples.

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NORRISTOWN, PENNSYLVANIA

Print Ins. 52 on Reader Service Card

eter range of 60-97. 4 pages. Urethane Div., The Dayton Rubber Co., Dayton 1, Ohio.

Print No. Ins. 216 on Reader Service Card

Manual on Meter for Measuring Dielectric Constant

A comprehensive new technical applications manual on a capacitance-operated proximity meter, TM-951-2, contains a complete description of the device, circuit and dimensional information, and numerous application specifics including layout and configuration details. Among applications outlined is use to measure dielectric constant of liquids or of continuous sheet or web materials. 28 pages. Aeronautical and Instrument Div., Robertshaw-Fulton Controls Co., Santa Ana Freeway at Euclid Ave., Anaheim, Calif.

Print No. Ins. 217 on Reader Service Card

Guide to Selection of RF Connectors By RG Cable Types

New guide to the selection of RF connectors by RG cable types includes a cross reference of cables versus applicable connectors. All versions of cable and connector types are listed. The folder also includes a guide for adapters which provide a means of connection between various solid-dielectric RF cable connector series. Category definitions given indicate current preferences over obsolescent components and their preferred replacement in RF transmission line applications. 4 pages. Schweber Electronics, 60 Herricks Rd., Mineola, L.I., N.Y.

Print No. Ins. 218 on Reader Service Card

"Teflon" Facilities Folder

Report on company facilities covers extruders to produce Teflon rod stock suitable for close-tolerance machining and severe electronic use, importance of quality control, equipment for high-speed production of specialty insulation, etc. 4 pages. Tri-Point Plastics Inc., 175 I.U. Willets Road, Albertson, L.I., N.Y.

Print No. Ins. 219 on Reader Service Card

Metalized Ceramic Insulator Bulletin

Technical Bulletin M-100, a one page data sheet, describes the use of metalized ceramic, glass, and mica components in preparing an electronic insulator for bonding to metal, thus permitting the finished assembly to be hermetically sealed. A photo illustrates typical components now offered, including metalized ceramic housings for hermetically sealed resistors, capacitors, transformers, diodes, and rectifiers; metalized solder seal terminals, delay line cores, printed circuits, and micromodule wafers. The types of metalized coatings and the available ceramic base materials, such as steatite and alumina, are listed. Metalizing Industries Inc., 338 Hudson St., Hackensack, N.J.

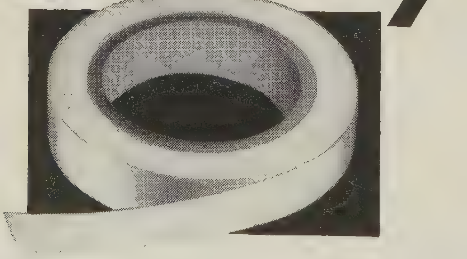
Print No. Ins. 220 on Reader Service Card

Data Sheet on Colored Flexible Insulators for Lead Clips

Data sheet gives complete information on new color range in flexible vinyl insulators for clip-equipped electric leads. Sheet lists advantages in testing, identification, and product appeal gained by fuller use of the new color range. 1 page. Mueller Electric Co., 1575 G East 31st St., Cleveland 14, Ohio.

Print No. Ins. 221 on Reader Service Card

CHEMO has: "TAPACITY"



"TAPACITY" . . . the capacity to produce the insulation tape you want when you want it . . . that's Chemo's reputation right across industry!

Chemo Tapes of TEFLON* are finding their way into more miles of dependable use daily.

Call on Chemo's "Tapacity" early and often!

CHEMO TAPES OF TEFLON* — Tapes from .001" to .125 in thickness; 1/8" and up in width. Continuous lengths. Values for 5 mil thickness: dielectric strength, 2000 volts per mil; tensile strength, 4000 p.s.i.; elongation, 350%. Maximum whiteness at no premium cost.

*Teflon—Dupont registered trademark

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Ask for Data Sheets on Chemo Tapes and Coatings

CPI

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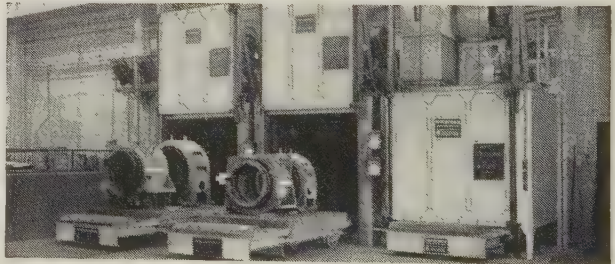
STANDARD OR SPECIALLY DESIGNED

YOUNG BROTHERS OVENS

for dependable, economical BAKING and DRYING in the ELECTRICAL INDUSTRY



Car-Bottom Type Stator Baking Ovens

The specialized knowledge gained in over 60 years of experience and in thousands of installations are available to meet your particular needs in Varnish Baking — Wire Enameling — Rubber and Plastic Curing, Paint and Enamel Baking — Glass Annealing — Service Shop Ovens. Young Brothers Batch or Conveyor Ovens will improve your product . . reduce your costs. Write for New Bulletin 157.

YOUNG BROTHERS COMPANY

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ESTABLISHED YBCo 1896

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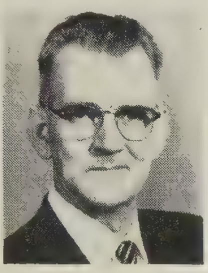
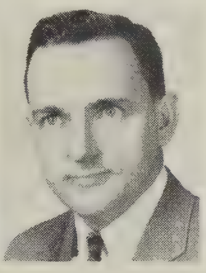
People in the News

Continental-Diamond Fibre Corp., Newark, Del. has appointed *Dr. W. M. Lair,* previously with Wrenn Paper Co., as director of research and development, and *A. H. Haroldson,* with CDF for 33 years, as associate director of research and development. The firm also has promoted sales representative *Howard J. Coffey* to Philadelphia district sales manager and named *Harold M. Dexter Jr.* as a sales representative in the Philadelphia district.

W. M. Lair


A. H. Haroldson

H. J. Coffey


H. M. Dexter

W. H. Middendorf, previously associate professor of electrical engineering at the University of Cincinnati. has been named director of research for the Cincinnati Development and Manufacturing Co., Cincinnati manufacturer of fiber glass-polyester insulation.

Union Carbide Plastics Co. has appointed *Benedict Letizia* as a technical sales representative in the Cincinnati office.

Hercules Powder Co., Wilmington, Del., has named *George H. Ripley* as chief engineer, and *Edward K. Lefren* as assistant chief engineer.

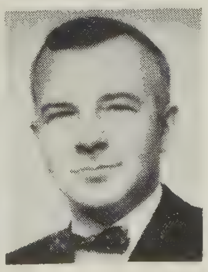
Sylvania Electric Products Inc., New York, has appointed *Alfred C. Viebranz* to the newly created position of vice president, marketing services, with responsibility for advertising, sales promotion, market research, distribution services, and sales management development. *Frank H. Bower,* formerly with Motorola Inc., has joined the Semiconductor Div. of Sylvania at Woburn, Mass., as engineering administrator. At Sylvania Electronic Systems, Waltham, Mass., *Charles E. Applegate* has been named staff specialist, new products. He previously was with Arthur D. Little Inc.

Taylor Fibre Co., Norristown, Pa., manufacturer of laminated plastics and fibre, has appointed *Richard L. Smith,* with the company since 1953, as district manager of the Rochester, N.Y. sales office. *Dr. Fred P. Baughman,* formerly with DuPont, has been appointed a group leader in the technical department to head up the physical chemistry-fundamental studies group section. *Joseph A. Morris,* previously sales service manager, has been named assistant sales manager. *Fred Jaeschke,* formerly sales service representative, has been appointed sales engineer in the Maryland, Virginia, and Washington, D.C. territory. *Edward Brewer* replaces *Jaeschke. Gordon Platt* has been reassigned from the Hartford office to the Philadelphia sales territory.

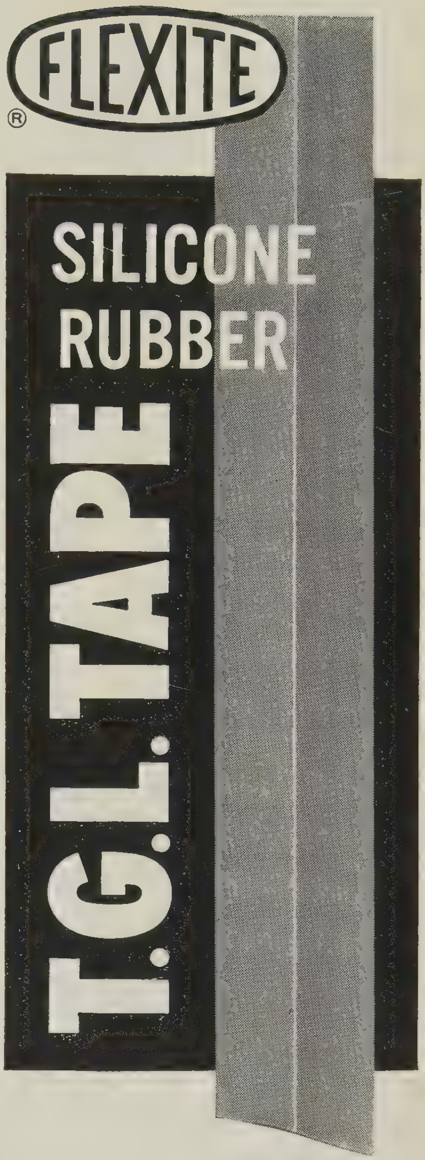
R. L. Smith

F. P. Baughman

J. A. Morris


R. H. Warner

Dr. Raymond H. Warner Jr., formerly with Bell Telephone Laboratories, has been named chief engineer, Diode Development for the



To satisfy the requirements for a self-adhering wrapping tape with all the well-known properties of silicone rubber, Markel has added to the *Line of Excellence* FLEXITE T.G.L. Silicone Rubber Triangular Guide Line Tape. The guide line cuts taping time and insures perfect lapping of the permanently resilient tape to produce void-free insulation with excellent electricals, and resistance to corona, oils, and weathering. Ask for samples.

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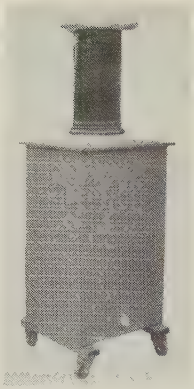
150 KV RMS TESTING TRANSFORMER



150 KV rms testing transformer for combination Dielectric Test Set and Corona Level Test Set (on casters for mobility). Unit is corona-free to 75 KV rms. High voltage oil-filled bushing is corona-free to 150 KV rms. Capacity of testing transformer is 15 KVA (also available in larger capacities). Size is 30″ X 36″ X 83″ high including the high voltage bushing, and the weight is 1100 pounds. Tank is filled with SF6 gas dielectric for weight reduction (may be filled with transformer oil, if desired). High voltage bushing is 30″ above top of tank.

Control cabinet for this high voltage section (not shown) contains all safety and convenience controls and meters, including a continuously adjustable output control to enable setting output anywhere from zero to full voltage.

APPLICATIONS: For Dielectric Testing in accordance with ASTM standards, Corona Testing, Research in connection with general missile program. For testing ceramic bushings, cable components, apparatus and insulation in general.

Ask for more information, now

Peschel Electronics, Inc.
Phone TRinity 8-3251
Towners Patterson, N.Y.

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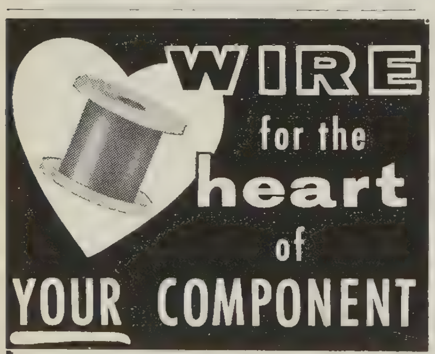

Wire drawn to your specifications (down to .00025″) in base and precious metals and alloys . . . supplied bare, enameled, ceramic insulated for use at 1000°F., or electroplated . . . to close tolerances.

Our research and development staff is available to solve YOUR wire problems.

Write for data on your specific needs.

SECON METALS CORP.
7 Intervale St., White Plains, N.Y.
WHite Plains 9-4757

SECON

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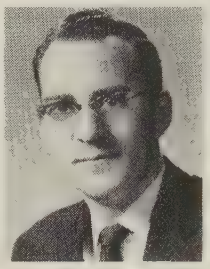
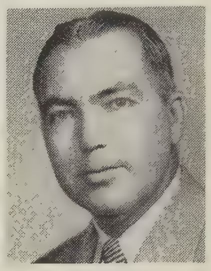
Semiconductor Div. of Motorola Inc., Phoenix, Ariz. *Dr. Robert J. Gnaedinger Jr.*, who also had been with Bell, has been named senior solid state chemist for the division.

Spruce Pine Mica Co., Spruce Pine, N.C., has elected *E. H. Farnam* as president, *S. A. Montague* as chairman, and *L. A. Conley* as vice president and secretary.

Chemplast Inc., East Newark, N.J., "Teflon" resin fabricator, has appointed *Myron L. Bailey* as manager of the sales service division.



M. L. Bailey



C. B. Vaughn

Charles B. Vaughn has been appointed manager, marketing, of the Insulator Dept., General Electric Co., Baltimore. He joined G-E in 1937 and was most recently manager, sales, for the Insulator Dept.

Allis-Chalmers Mfg. Co., Milwaukee, has appointed *Robert F. Alsworth* assistant engineer in the motor and generator dept.; *Richard E. Birner* and *Paul Cain*, assistant engineers in the steam turbine dept.; *Noel P. Grimm, Gerald C. Kutsch, Roger W. Schlicht*, and *Wayne J. Severson* as assistant engineers in the nuclear power dept.; and *James W. Adam* and *Roger E. Kiel* as engineering scientists in the Research Div.

Don McPherson has been named district sales representative of the Cleveland territory of the Magnet Wire Div., Essex Wire Corp.

Philco Corp. has appointed *George V. Woodrow Jr.* as director of weapons systems engineering for the Government and Industrial Group, Philadelphia. He had been chief engineer for research and development, Bendix Aviation Corp.

N. B. Cawthorne, formerly director of the High Temperature Insulation Div., has been appointed technical director of L. Frank Markel & Sons, Norristown, Pa., producer of flexible insulating tubing and high temperature insulated wire.

Fred Poles, in the industry for 23 years, has been named manager of research and development, The Star Porcelain Co., Trenton, N.J., manufacturer of ceramics.

Fred Poles

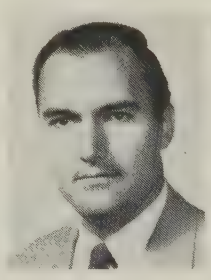
S. E. Tinkham

Sumner E. Tinkham has been appointed vice president, engineering, of Tech Art Plastics Co., Morristown, N.J. He had been with Boonton Molding Co. as executive engineer.

Nils E. Attemann, with the company since 1951, has been promoted to manager of the Semiconductor Div., Cramer Electronics Inc.

Goldak Co., Glendale, Cal., electronic instrumentation firm, has named *Joseph W. Hans* as production manager.

Forrest E. Behm, previously general manager of the New Products Div., has been named manager of manufacturing for the Electrical Products Div., Corning Glass Works, Corning, N.Y. He is succeeded by *Rushmore H. Mariner*, whose responsibilities will include new glasses and ceramics.



F. E. Behm

R. H. Mariner

James R. Fisher, previously with Eastman Kodak Co., has been appointed a product specialist on piezoelectric ceramic materials for Sprague Electric Co., North Adams, Mass.

Lyle L. Backer has been named executive vice president of Thermal Controls Inc. and O.K. Electronics, Nutley, N.J., producers of relays, fuses, and thermal devices.

Harvey J. Thibodeau has been apointed sales administrator of Nylok-Detroit Corp., producer of self-locking nd sealing threaded fasteners.

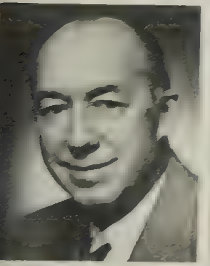
Contacts Inc., Wethersfield. Conn., lectrical and electronic manufacturer, as elected former president *Roger W. Spellman* to chairman of the oard and *Kenneth L. Emmert* as resident.

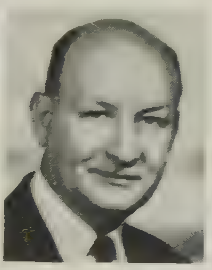
R. W. Spellman

K. L. Emmert

Electrical Maintenance Equipment Co., Philadelphia wire and insulation distributor, has appointed *James J. Lawson* as vice president, *L. R. Fink* as sales manager, and *William Murphy* as director of purchases.

Leo S. Sullivan, vice president in charge of sales for the Russell Mfg. Co., Middletown, Conn., died recently in New York City as the result of a heart attack. He had been with the firm for 37 years.


L. S. Sullivan


H. F. Hild

Henry F. Hild, general manager of he firm's Indiana Div., Indiana, Pa., as been elected an assistant vice president of Robertshaw-Fulton Controls o.

Dr. Saul M. Cohen, with the company since 1954 as a research chemist, as been appointed a group leader in hawinigan Resins Corp.'s research ept. with responsibility for organizng a group for exploratory research the synthesis of totally new plastic esins.

C. L. Christiansen, formerly in harge of electrical industry sales in e New York City area, has retired om Dow Corning Corp. to assume new position as vice president in

MOSINEE MAKES MAGIC WITH PAPER

For quality laminates . . . Mosinee Saturating and Impregnating Papers

- These Mosinee papers give you precision control over quantity and rate of resin absorption.
- Mosinee saturating papers are made to your specifications.
- You'll get the exact penetration rate, degree of saturation, and resin pickup you desire.
- Apparent density as reflected by basis weight and caliper will be precisely as you have ordered.
- Quality will be uniform from roll to roll . . . from carload to carload . . . as long as you order.

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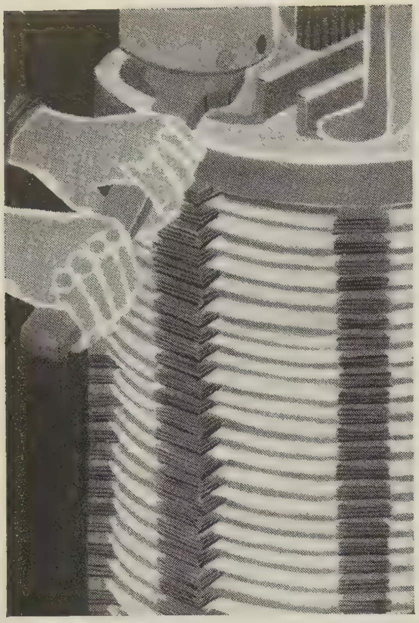

LOW-COST
WEST VIRGINIA
PRESSBOARD INSULATION

. . . a moneysaver
for every purpose

PRESSITE . . . an absorbent board for air, oil, and askarel transformers; also for capacitors.

ELECTRITE . . . a hard board, with natural rosin sizing to resist moisture. Excellent for punchings and fabricated parts.

DENSITE . . . an extremely hard board. Sized for moisture resistance or unsized for applications in oil.

All three types are widely replacing more costly insulation.

Made of 100% virgin kraft pulp produced at our own pulp mill, they are free of metallic particles. They offer higher dielectric, physical, and chemical properties.

Uniform quality assures consistent dependability. Colors are natural kraft, black, and brown depending on type. Available in a wide range of thicknesses.

Ask for Underwriters' Laboratories report #E3987. Write Board Products Sales, West Virginia Pulp and Paper Company, 230 Park Avenue, New York 17, New York.

West Virginia Pulp and Paper

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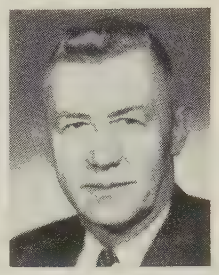
charge of promotion for the Golden Years Research and Development Center, Ridge Manor, Fla., a non-profit corporation.

Al Corning, formerly with Continental Can Co., has joined Insulation Manufacturers Corp., Chicago, electrical insulation distributor and fabricator, in a sales capacity.

Al Corning



H. A. Frey

Howard A. Frey, formerly manager of engineering, has been appointed general manager of the Insulator Dept., General Electric Co., Baltimore. In G-E's Insulating Materials Dept., Schenectady, *Dr. John M. Witzel*, who had been manager of varnish and wire enamel engineering, has been promoted to manager of engineering. *Harland P. Sisk*, previously manager of manufacturing, has been appointed general manager of G-E's Distribution Transformer Dept., Pittsfield, Mass.

James K. Galvin, previously manager of the Cleveland territory, has been named general sales manager for the Acme Wire Co., New Haven, Conn. *Wilbur F. Hafer* has been appointed representative in Cleveland. and *Ray N. Schafer* has been named representative in the Southern Ohio and Indiana territories.

William E. Tyler, previously vice president in charge of finance and secretary, has been elected president of H. I. Thompson Fiber Glass Co., Los Angeles. He succeeds *Harry I. Thompson*, who becomes chairman of the board.

Dr. Kenneth W. Gardiner, who joined the company in August 1959 as assistant chief research chemist. has been appointed chief research chemist of Consolidated Electrodynamics Corp., Pasadena. *Robert A. Hall*, who also joined the company last year, has been appointed administration manager of the Datalab Div. of Consolidated at Pasadena.

Charles W. Bing, formerly with Weston Instrument Corp., Newark, has joined Mid-Eastern Electronics Inc., Springfield, N.J., instrument manufacturer as chief mechanical engineer.

C. W. Bing

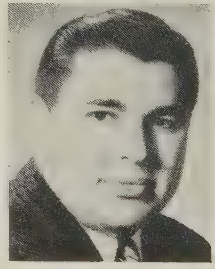
J. M. Thompson

John M. Thompson, with the government for 25 years and most recently chief of the test facilities laboratory at Rome Air Development Center, has become vice president and general manager of Itemlab Inc., Port Washington, N.Y., environmental testing laboratory.

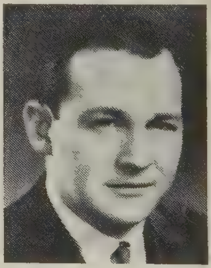
James O. Weldon and *Lee D. Webster* have been elected directors and named to the executive committee of Ling-Altec Electronics Inc., Dallas. Webster was also promoted from vice president to executive vice president.

Robert H. Hill, with the company since 1917, has been named director of sales for the Sherwin-Williams Co., Cleveland paint and varnish producer.

Seymour M. Miller, previously senior industrial engineer at the General Instrument Corp., has been appointed a time study and methods engineer at ESC Corp., Palisades Park, N. J., transformer manufacturer.



S. M. Miller



J. T. Hastings

John T. Hastings, with the company since 1955 and previously supervisor of sales in the textile fibres dept. in New York, has been promoted to assistant to the manager of the industrial sales division of the Dobeckmun Co., a division of the Dow Chemical Co., Cleveland.

Industry News

The Spencer Products Group of *Texas Instruments' Metal & Controls Div.* has relocated its precision controls package design facility from Burbank, Cal., to Attleboro, Mass.

International Wire Products Corp., Midland Park, N.J., has merged with *Carlisle Corp.*, Carlisle, Pa. International, an electrical conductor manufacturer, will operate as a wholly owned subsidiary of *Carlisle*, rubber and plastic producer.

Tensolite Insulated Wire Co. Inc., Tarrytown, N.Y., has named *C.F.L. Corp.*, Denver, as regional representative for its line of high temperature wire and cable products.

Associated Testing Laboratories Inc., Caldwell, N.J., manufacturer of environmental test equipment, is moving into a new plant of 30,000 sq. ft. costing approximately $500,000 in Wayne, N.J.

The Carwin Co., North Haven, Conn., isocyanate producer, has absorbed its wholly owned subsidiary *Carwin Polymer Products Inc.*

Paul Martin Platzman, formerly with *The Narda Ultrasonics Corp.*, has formed *Ultrasonic Industries Inc.* at Albertson, L.I., N.Y., to manufacture ultrasonic cleaners.

Over-all responsibility for systems management of *General Telephone & Electronics Corp.'s* government projects has been centralized within *Sylvania Electronic Systems*, a division of *Sylvania Electric Products Inc.*, New York. *GT&E* has also announced the formation of *General Telephone & Electronics Laboratories Inc.*, a wholly owned subsidiary which will engage in a wide range of scientific research activities in the communications and electronics field. Nucleus of the research organization will be the Bayside, N.Y., research laboratories of *Sylvania Electric Products Inc.* The new subsidiary has completed arrangement for the acquisition of land in the Palo Alto, Cal., area as a site for future research facilities for the entire *GT&E* organization.

The Parts Div. of *Sylvania Electric Products Inc.*, Warren, Pa., has announced plans for the construction of an 18,000 sq. ft. weld plant.

Union Carbide Plastics Co., div. of Union Carbide Corp., has increased plant capacity at South Charleston, W. Va., for the production of polyvinyl ethyl ether resins used in pressure-sensitive adhesives for electrical tapes.

Servo Corp. of America, Hicksville, N.Y., electronic manufacturer, has acquired *Electro-Pulse Inc.*, Culver City,

Despite terrific temperature changes, abrasions and repeated immersions in acids, oils and water—these stainproof electrical tapes have demonstrated their ability to seal . . . hold . . . and insulate without weakening. Available in three versions to meet your Class H insulation requirements.

7000-G: Silicone adhesive on one side.

7100-G: Silicone adhesive on both sides.

7300-Extra Thin: Flexible Mylar® polyester film backing. Temperature range: 80° to +325°F.

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HYDRAZINE FLUX permits prefluxing. This means you can hold prefluxed parts before soldering—an efficiency measure that can increase manhour output substantially.

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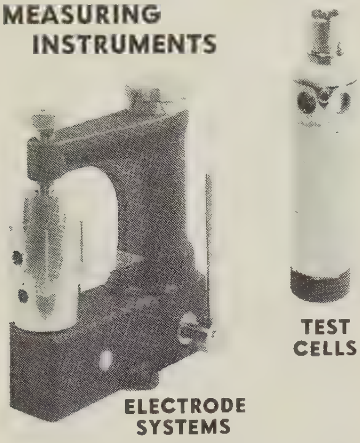

- MEASURE dielectric constant, power factor, conductivity on any electrical insulating material — liquid, solid or fibrous.
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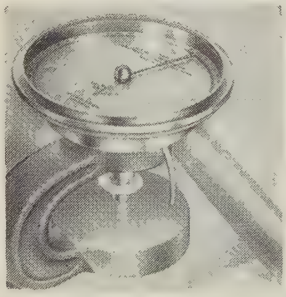
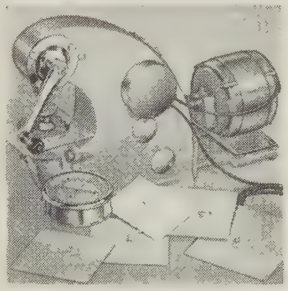


Portable and other models also available



CADYTEST INSTRUMENTS
Register Thickness, Burst Strength and Basis Weight.
Write for Brochure.

E. J. CADY & COMPANY
682 N. Harlem Avenue, River Forest, Illinois
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Cal., via a stock transfer agreement. The West Coast electronics firm will be operated as a wholly owned subsidiary.

Grieve-Hendry Co. Inc., ten-year-old industrial and laboratory oven and furnace manufacturers, have moved to new quarters at 1350 N. Elston Ave., Chicago 22.

The Huse-Liberty Mica Co., Peabody, Mass., insulation firm, now stocks and fabricates "Mykroy" glass-bonded mica products.

Taylor Fibre Co., Norristown, Pa., laminated plastic and fibre producer, has formed a separate molded parts department.

Standard Packaging Corp., New York, whose products include flexible insulation laminates, has announced plans for a merger with *Brown & Bigelow.*

Atlas E-E Corp., Woburn, Mass., electronic component manufacturer, has changed its name to *Atlee Corp.* In addition, the firm has acquired *Wesco Electrical Co. Inc.*, Greenfield, Mass., producer of high voltage capacitors and power supplies. *Wesco* will be operated as a wholly owned subsidiary.

Continental Copper & Steel Industries Inc., New York, has announced plans for entering the electronics field through the acquisition of the newly formed *Technitrol Corp.* and production facilities at Union, N.J. The first product to be developed will be a cable tester. *Continental* also is installing a copper rod rolling mill for its *Hatfield Wire & Cable Div.* at Linden, N.J., adjacent to the new *Hatfield Insulated Wire & Cable* plant.

Chance Vought Aircraft Inc., Dallas, has acquired control of *Information Systems Inc.* and *Panellit Inc.* in Skokie, Ill., automatic control systems companies.

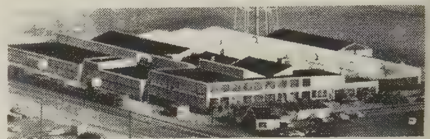
Chase-Foster Inc., Providence, R.I., laminated electrical insulation material manufacturer, has named the following five regional representatives: *L. K. Detwiler* for metropolitan New York, Connecticut, and New Jersey; *Smith of Philadelphia* for Eastern Pennsylvania and peninsular states; *Western Fibrous Glass Products* for 11 Western states; *E. R. Benson Co.* for Minnesota; and *E. A. Dickenson Assoc.* for Wisconsin.

Blue M Electric Co., Blue Island, Ill., has established *Blue M Engineering Co.*, Los Angeles, for sales and service of industrial and environmental temperature controlled equipment.

Motorola Inc. will expand its Phoenix, Ariz., seminconductor plant by at least 100,000 sq. ft. and perhaps as much as 200,000 sq. ft. over the next 18 months.

J. J. Glenn & Co., Chicago, has been named as Midwest territorial representative for Polyglas armature banding tape made by *Pittsburgh Electrical Insulation Co. Inc.*

Barium & Chemicals Inc. of Willoughby, Ohio, has purchased a 165,000 sq. ft. plant at Steubenville, Ohio, for the production of products used in electronics, glass, plastics, ceramics, and other industries.

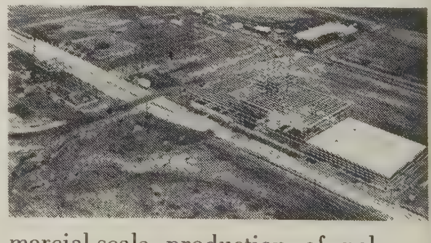


New fabricating and warehouse facilities have been established in Glendale, Cal., by *Synthane Corp*, Oaks, Pa., laminated plastics manufacturer.

Giannini Scientific Corp., New York, has acquired *Flight Research Inc.*, Richmond, Va., manufacturer of aircraft, control, and photographic equipment.

B. F. Goodrich Co. had sales of $771,591,342 in 1959 compared with $697,296,556 in 1958, an increase of 10.7%. Net income was $37,580,186 compared with $35,457,421, an increase of 6.0%.

General Electric Co. reports 1959 sales of $4,349,508,529, up 6% above 1958, and 1959 earnings of $280,242,123 or $3.19 a share, up 15% above 1958. G-E also reports that its multimillion-dollar, multimillion-pound-per-year plant for the commercial-scale production of polycarbonate resin is expected to be completed and in operation near Mount



Vernon, Ind., by the third quarter of 1960. G-E has reassigned its *Atomic Products Div.* to its newly formed *Electric Utility Group* headed by Clarence H. Linder, vice president. The division was previously a part of the *Electronic, Atomic and Defense Systems Group.*

Minnesota Mining & Mfg. Co., St. Paul reports 1959 sales of $500,675,932 and common stock earnings of $63,564,729 or $3.74 per share compared with 1958 figures of $376,293,016 (sales) and $43,879,033 (earnings) or $2.58 per share. A large part of the increase is due to consolidation of worldwide operations. Tape and allied products accounted for 21% of the sales, electrical products for 16%, and chemicals and plastics for 6%. A three-for-one split of common stock has been recommended for stockholder approval by the board of directors.

Viking Wire Co. Inc., magnet wire manufacturer, has completed its new 40,000-sq. ft. plant in Danbury, Conn. The plant is operating on a three shift, seven-day a week basis.

Sylvania Electronic Tubes, a division of *Sylvania Electric Products Inc.*, plans to build a new electron tube research and development center at Emporium, Pa.

Robotron Corp., Detroit, electronic control manufacturer, has completed construction of a 12,500 sq. ft. plant addition. The company also announced the opening of a new subsidiary, *Robotron of Canada, Ltd.*, at Sandwich West, near Windsor, Ont.

Howell Electric Motors Co., Howell, Mich., has acquired for an undisclosed sum the flat-type motor line of the *Diehl Mfg. Co.*, electrical division of the *Singer Mfg. Co.* Howell will produce the newly acquired line at its Leland Ohio Electric Div. plant in Dayton.

Riegel Paper Corp. has opened a branch sales office in Indianapolis at 150 West Market St. under the direction of C. W. Hoffman, Midwest sales manager.

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- ***Cured Tapes:*** Silicone rubber coated tapes in many variations of thickness, silicone compound and base fabric.
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- ***Self-Adhering Tapes:*** A self-adhering silicone rubber coating on glass or other fabrics.

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Insulation
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Dates to Circle

Meeting and Convention Notices

Mar. 30-Apr. 1 . . . American Power Conference, sponsored by AIEE and ASME, Sherman Hotel, Chicago.

Apr. 4-6 . . . AIEE, Southwest District Meeting, Shamrock Hilton Hotel, Houston, Texas.

Apr. 4-8 . . . Nuclear Congress, Engineers Joint Congress, sponsored by AIEE, IRE, and ACM, Coliseum, New York, N.Y.

Apr. 5-9 . . . Ninth Electrical Engineers Exhibition, Assn. of Supervising Electrical Engineers, Earls Court, London.

Apr. 6-8 . . . Institute of Environmental Sciences, National Meeting and Exhibit, Biltmore Hotel, Los Angeles.

Apr. 7-8 . . . SPI, 17th Western Section Conference, New Riviera Hotel, Palm Springs, Calif.

Apr. 12-14 . . . AIEE, Electrical Engineering in Space Technology Conference, Hotel Baker, Dallas, Texas.

Apr. 12-14 . . . AIEE, East Central District Meeting, Daniel Boone Hotel, Charleston, W. Va.

Apr. 20-22 . . . SPI, Third Annual Fluorocarbon Division Meeting, Hotel Roosevelt, New Orleans, La.

Apr. 20-22 . . . Twelfth Annual Southwestern Conference and Electronics Show, sponsored by Houston Section, IRE, Shamrock Hilton Hotel, Houston, Texas.

Apr. 25-26 . . . SPI, 18th Annual Canadian Section Conference, London Hotel, London, Ont., Canada.

Apr. 25-29 . . . American Welding Society, Annual Meeting and Welding Show, Biltmore Hotel and Great Western Exhibit Center, Los Angeles.

Apr. 27-29 . . . AIEE, Great Lakes District Meeting, Pfister Hotel, Milwaukee, Wis.

May 1-5 . . . National Assn. of Electrical Distributors, 52nd Annual Convention, Memorial Auditorium, Dallas.

May 1-5 . . . Electrochemical Society, Technical Meeting, La Salle Hotel, Chicago.

May 2-4 . . . AIEE, North Eastern District meeting, Sheraton Biltmore Hotel, Providence, R.I.

May 2-4 . . . IRE, National Aeronautical Electronics Conference, Biltmore and Miami-Pick Hotels, Dayton, Ohio.

May 3-5 . . . Western Joint Computer Conference, sponsored by AIEE, IRE, and ACM, Jack Tar Hotel, San Francisco, Cal.

May 4-5 . . . The Wire Assn., Electric Wire & Cable Section Regional Meeting, Sheraton Hotel, Philadelphia.

May 8-11 . . . NISA, Annual Convention, Hotel Fontainebleau, Miami Beach, Fla.

May 10-12 . . . Electronic Components Conference, sponsored by AIEE, IRE, EIA, and WCEMA, Hotel Washington, Washington, D.C.

May 12-13 . . . SPI, National Plastics Molder & Suppliers Conference, American Hotel, Bal Harbour, Fla.

May 18-20 . . . EIA, 36th Annual Convention, Pick-Congress Hotel, Chicago.

May 24-26 . . . IRE, 7th Regional Technical Conference and Trade Show, Olympic Hotel, Seattle, Wash.

May 24-26 . . . IRE, Armed Services Communication and Electronics Association Convention and Exhibit, Sheraton-Park Hotel, Washington, D.C.

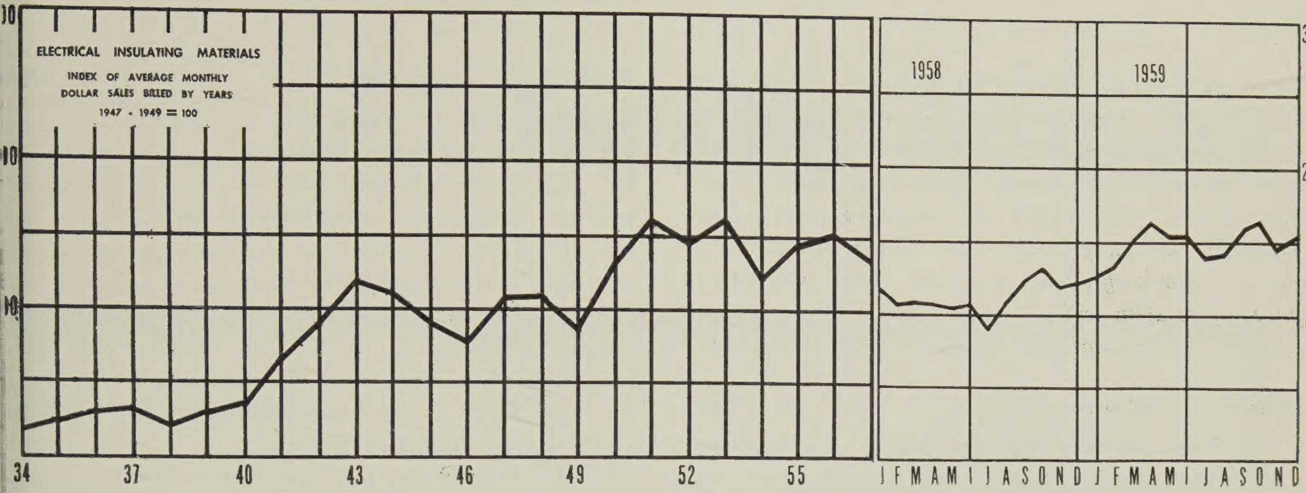
June 6-8 . . . Institute of Appliance Manufacturers, 28th Annual Convention and Exhibit, Netherland Hilton Hotel, Cincinnati, Ohio.

June 10-26 . . . British Exhibition of Industry, Technology, Science, and Culture, sponsored by the Federation of British Industries, Coliseum, New York City.

Abbreviations Used in Notices

AIEE	—American Institute of Electrical Engineers
ASTM	—American Society for Testing Materials
ASME	—American Society of Mechanical Engineers
ASA	—American Standards Assn.
IRE	—Institute of Radio Engineers
EIA	—Electronic Industries Assn.
NEMA	—National Electrical Manufacturers Assn.
NISA	—National Industrial Service Assn.
SPE	—Society of Plastics Engineers
SPI	—Society of the Plastics Industry
WCEMA	—West Coast Electronic Manufacturers Assn.

NEMA Electrical Insulation Index



	Dec. '59	Nov. '59	Dec. '58
dex series	154	141	124
ec. '59 point change from other mos.		+13	+30
ec. '59 % change from other months		+9	+24

dex is based on 1947-1949 average month, inclusive=100

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Materials Used in Electrical Insulation Index

- Industrial Laminated Products
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- Vulcanized Fibre
- Varnished Tubing and Saturated Sleeving (From May, 1952)

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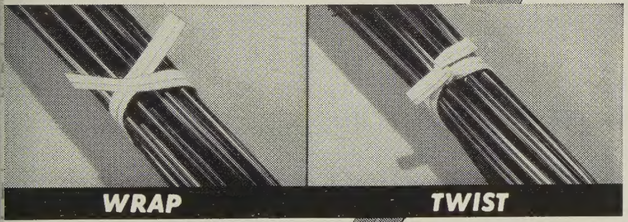

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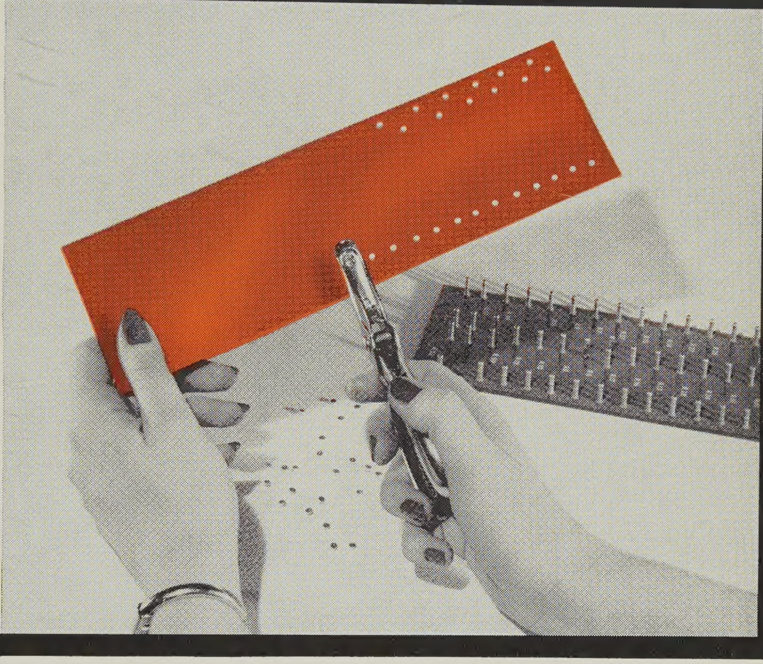

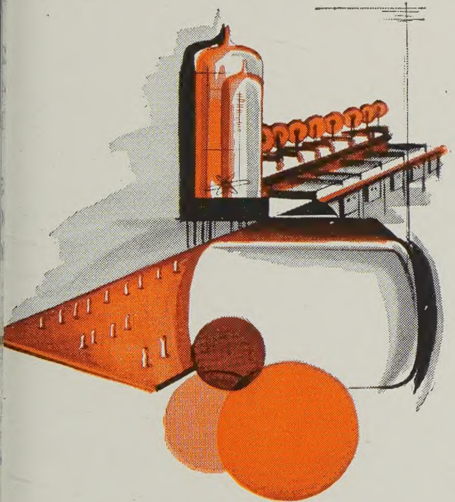

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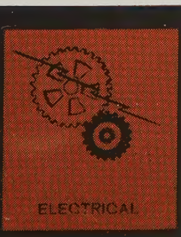
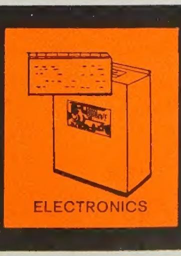
If your plans call for a dependable plastic laminate with excellent punching characteristics, specify G-E TEXTOLITE 11572. For complete information write: Laminated Products Department, Section I-40, General Electric Company, Coshocton, Ohio.





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BEN-HAR "1151"
and get as many as 4 different sleeving sizes

Now with one size of Ben-Har "1151" extruded silicone rubber fiberglass sleeving you can cover as many as four different size applications. Ben-Har "1151" is so tough that it permits expansion of up to 400% increase in a.w.g. size without typical end fray, coating fracture, etc. Easy assembly and snug fit over irregular knobs, terminals, and connectors are assured. Inventories can be greatly reduced because one size Ben-Har "1151" will do the job of several old style "dip coated" sleeving sizes.

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Exclusive Extrusion Coating (pat. pend.) with the new super-tough **durasyl** silicone rubber makes Ben-Har "1151" superior to other Class "H" sleevings in physical, mechanical and electrical properties. Every inch is inspected electronically, guaranteeing reliability never before possible.

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